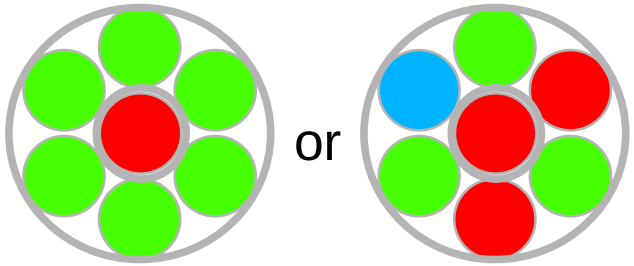
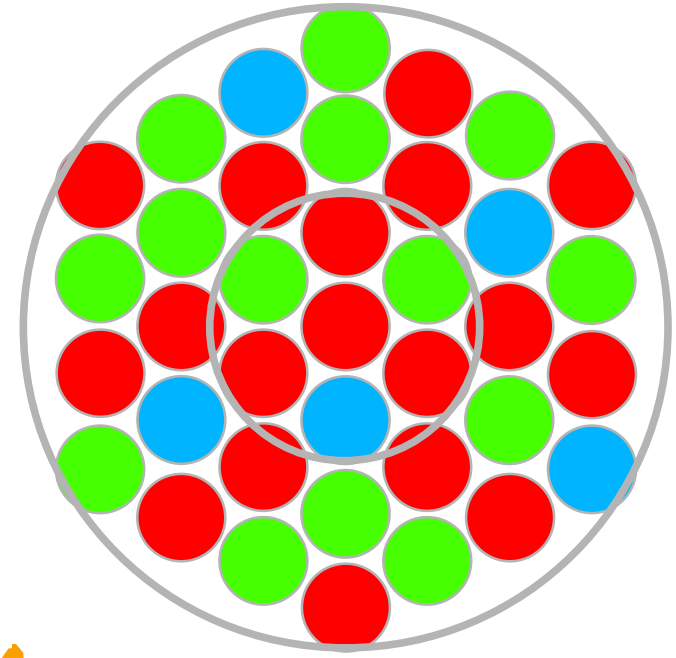
# The Midget and Parasol Channels

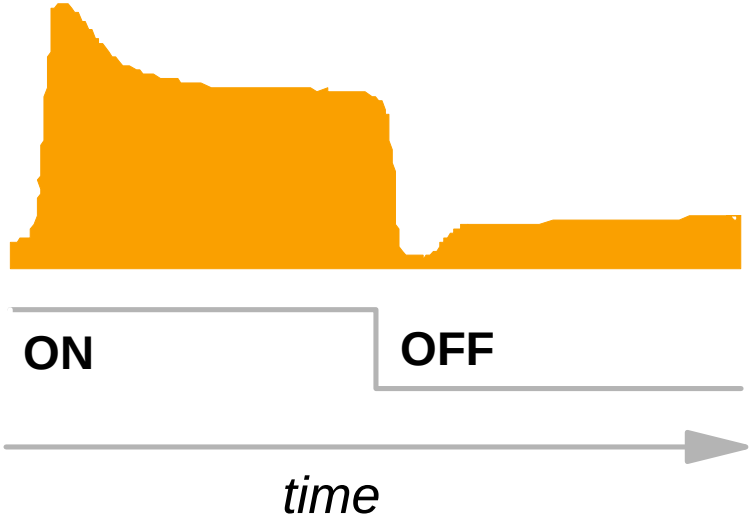
## MIDGET SYSTEM

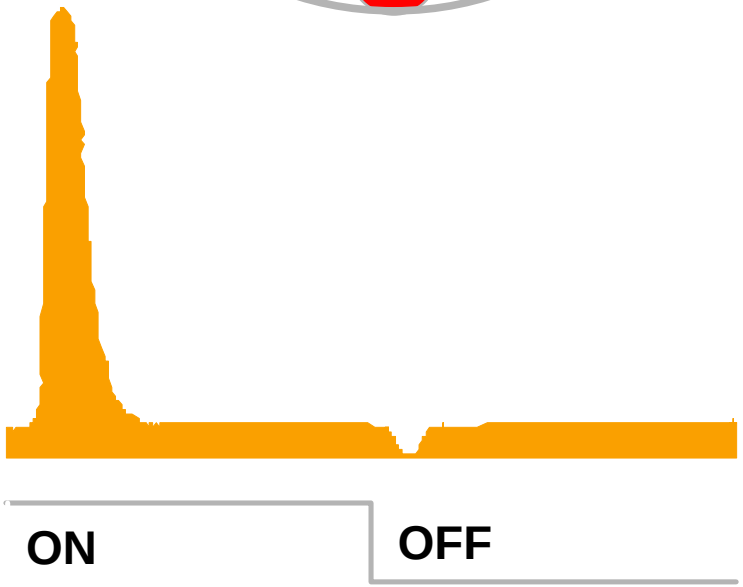



## PARASOL SYSTEM

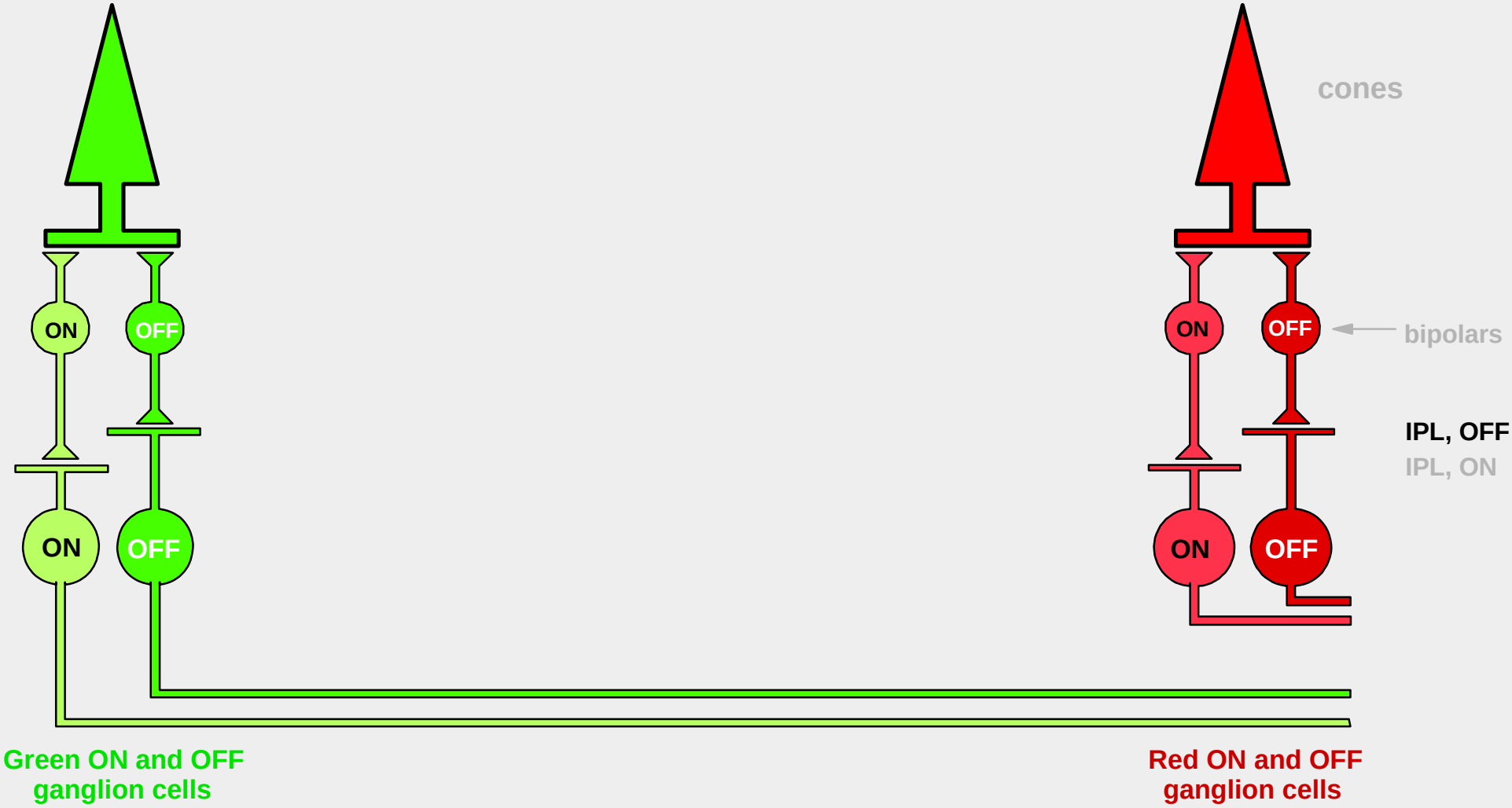


***Neuronal response profile***

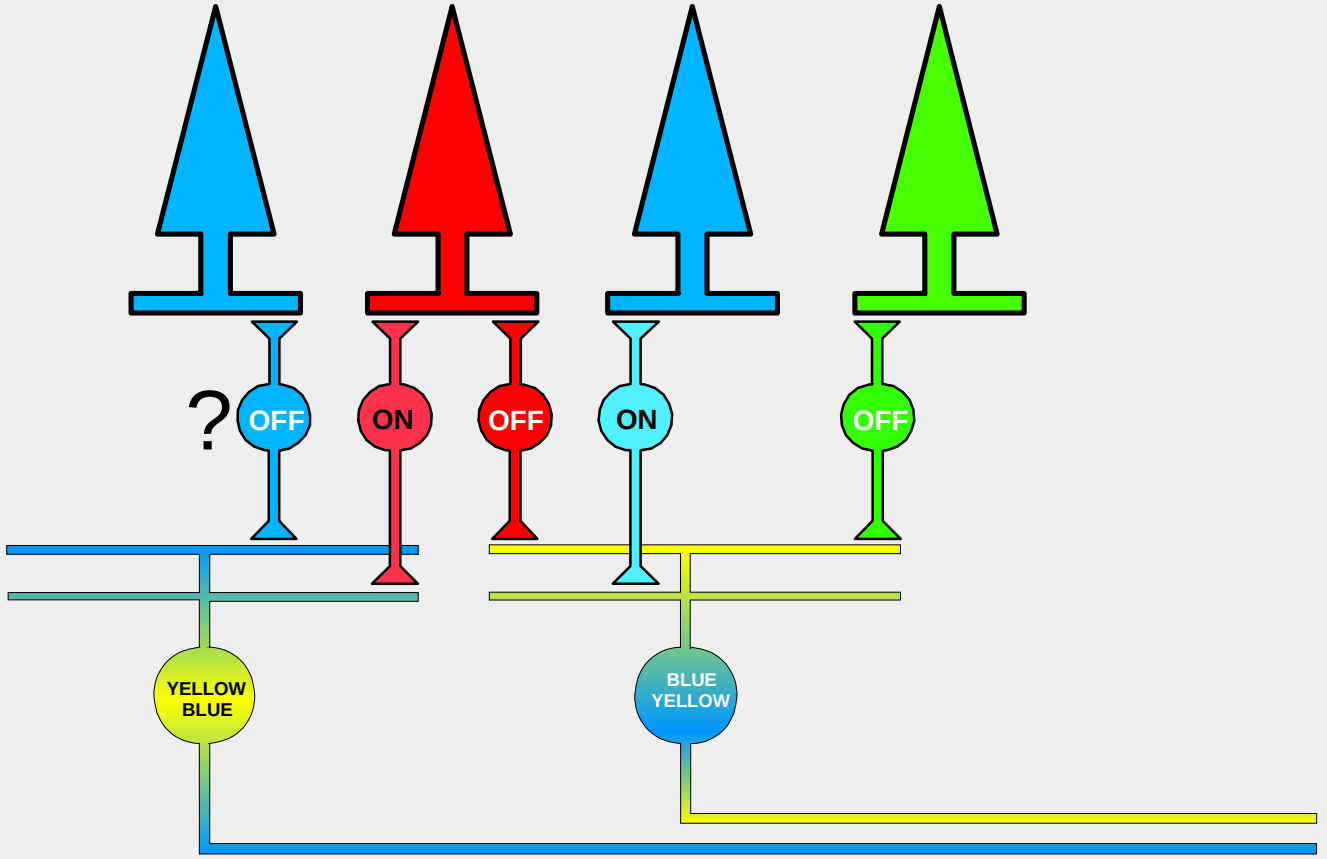


# Midget system



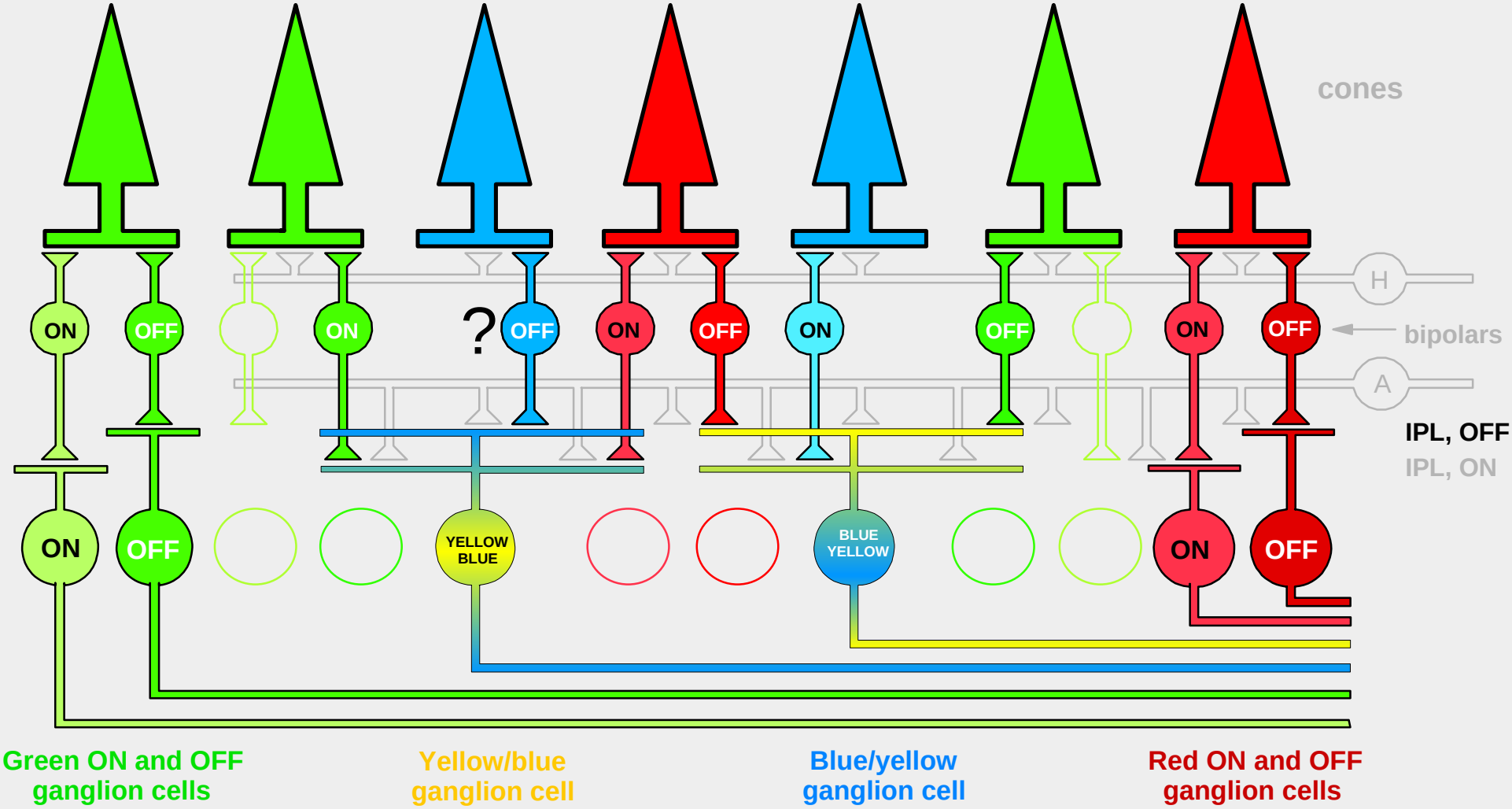
# Blue/yellow system



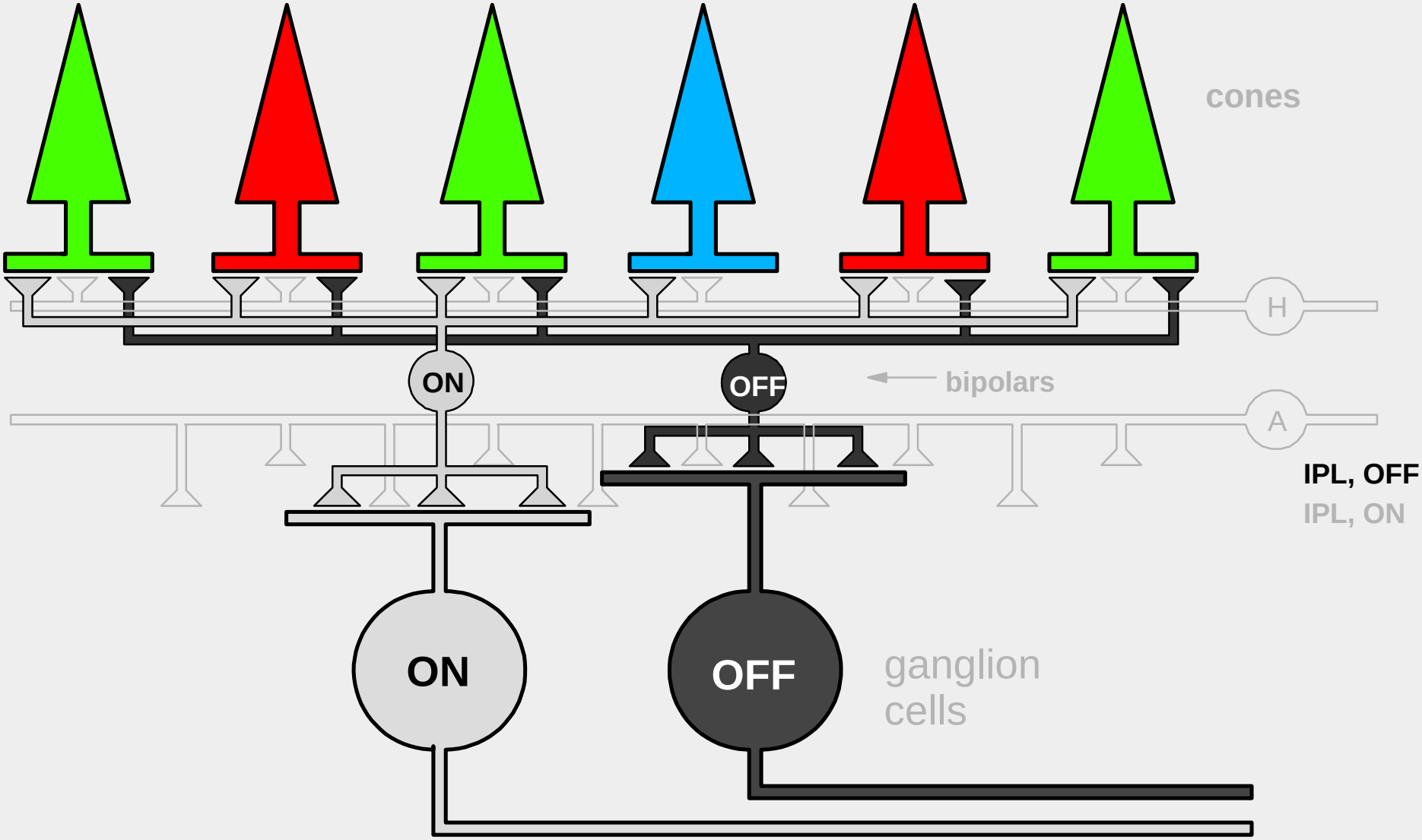

Yellow/blue ganglion cell

Blue/yellow ganglion cell

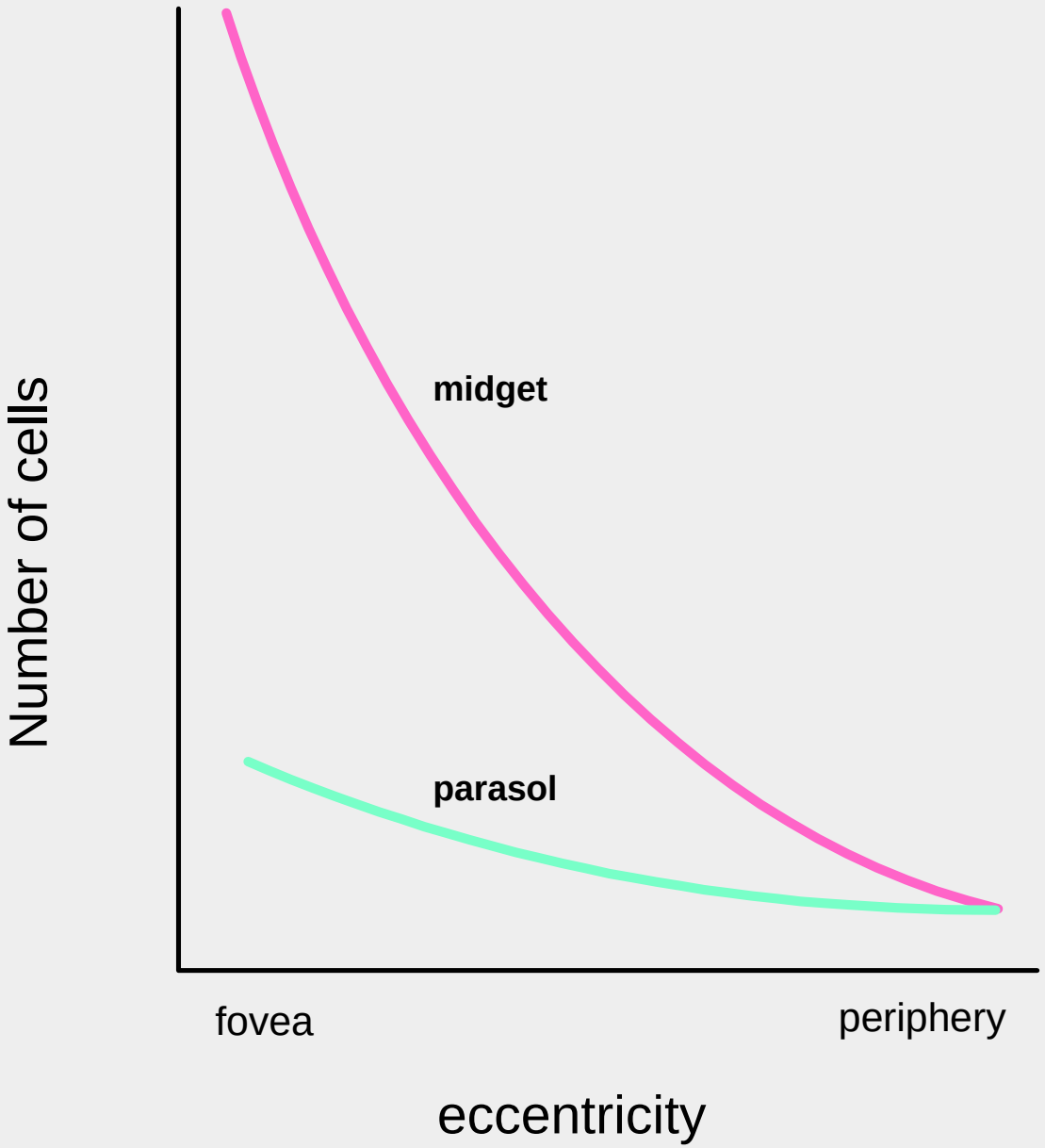
# Midget and blue/yellow system

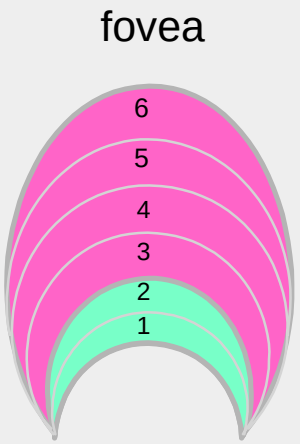


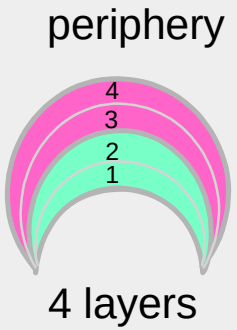
# Parasol system



# Number of midget and parasol cells per unit area as a function of eccentricity



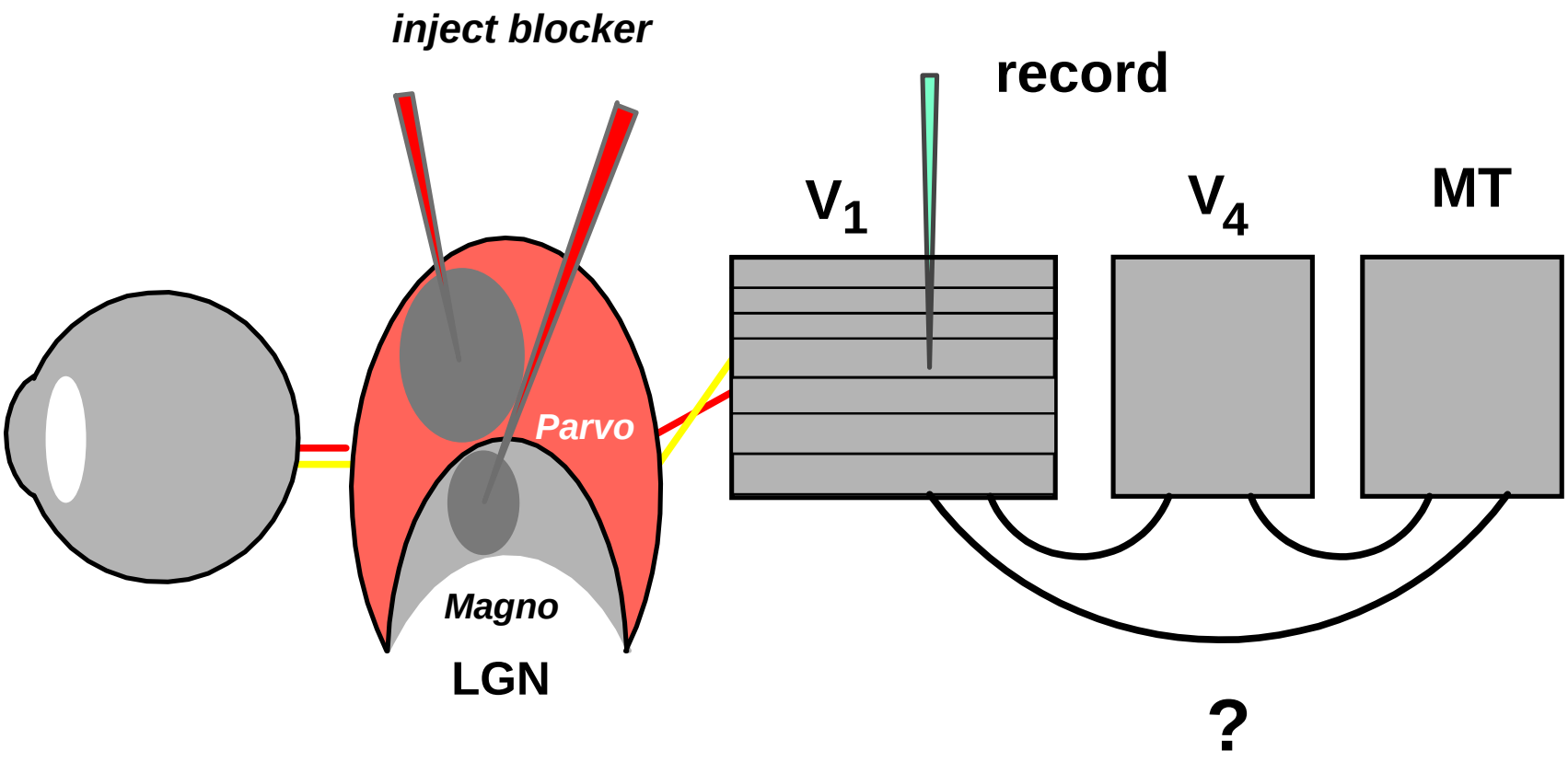

midget/parasol ratio:

fovea: 8 to 1 periphery: 1 to 1

# Projections of the retinal ganglion cells

# The central connections of the midget and parasol channels

# Tissue block with injections



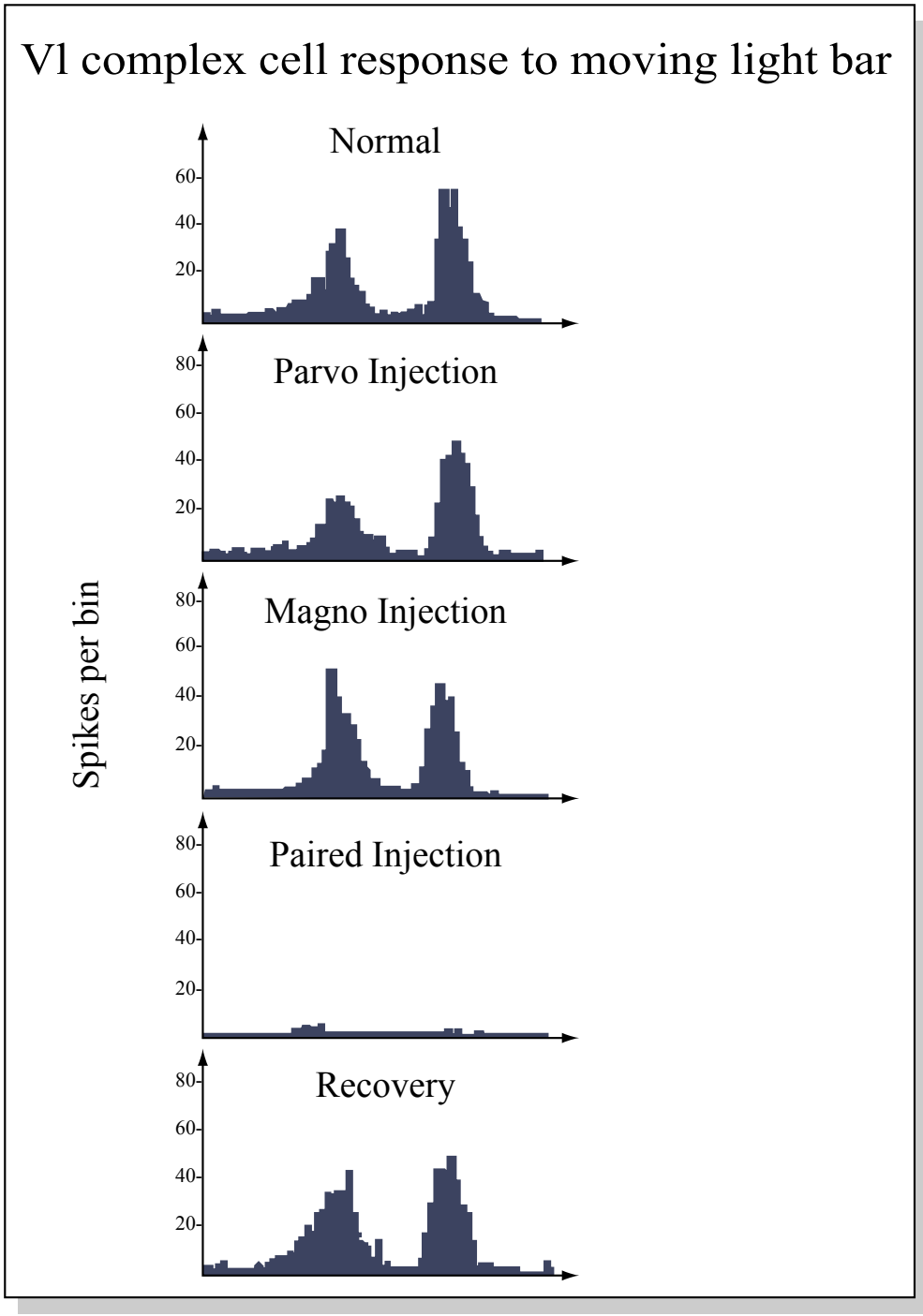
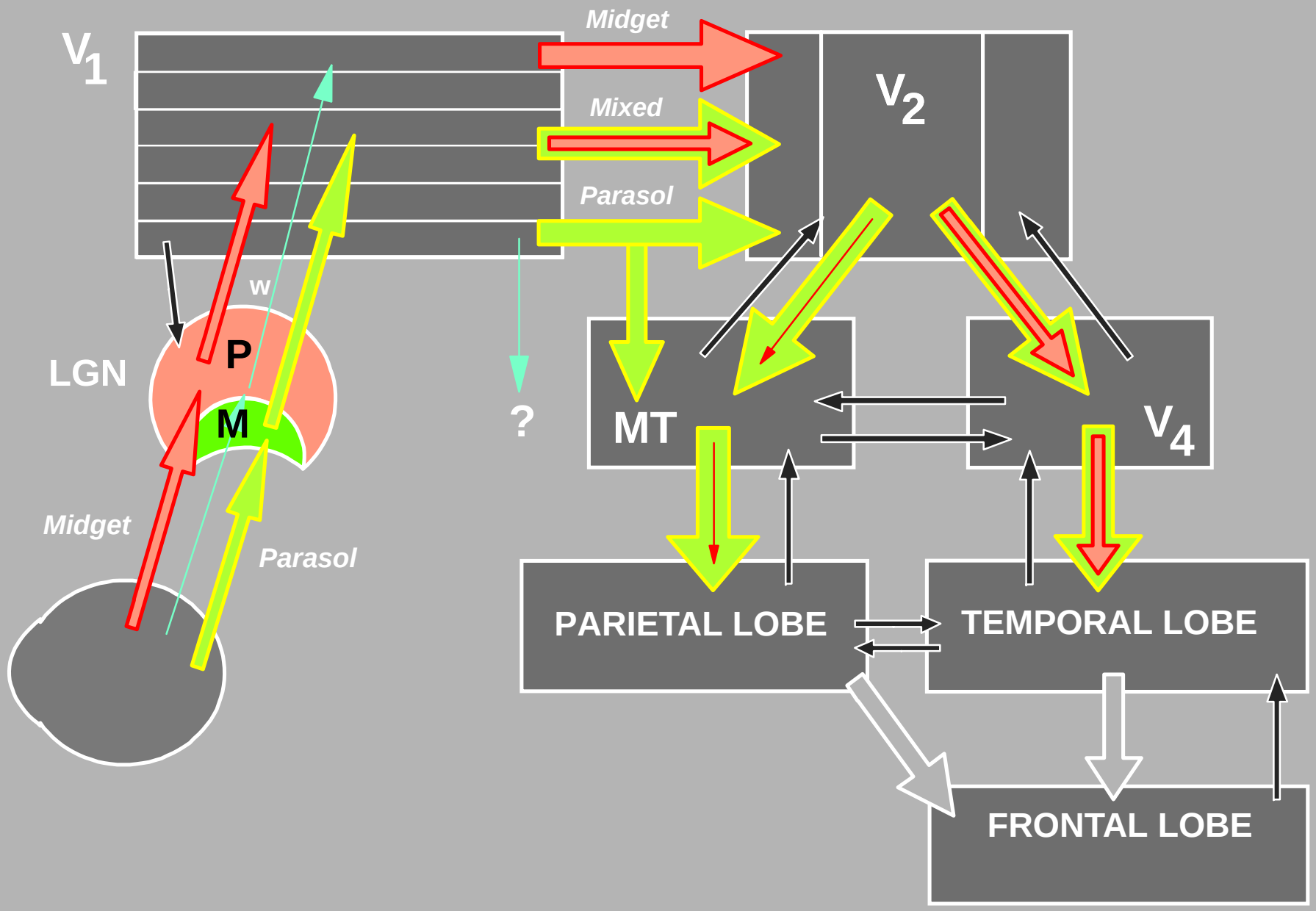


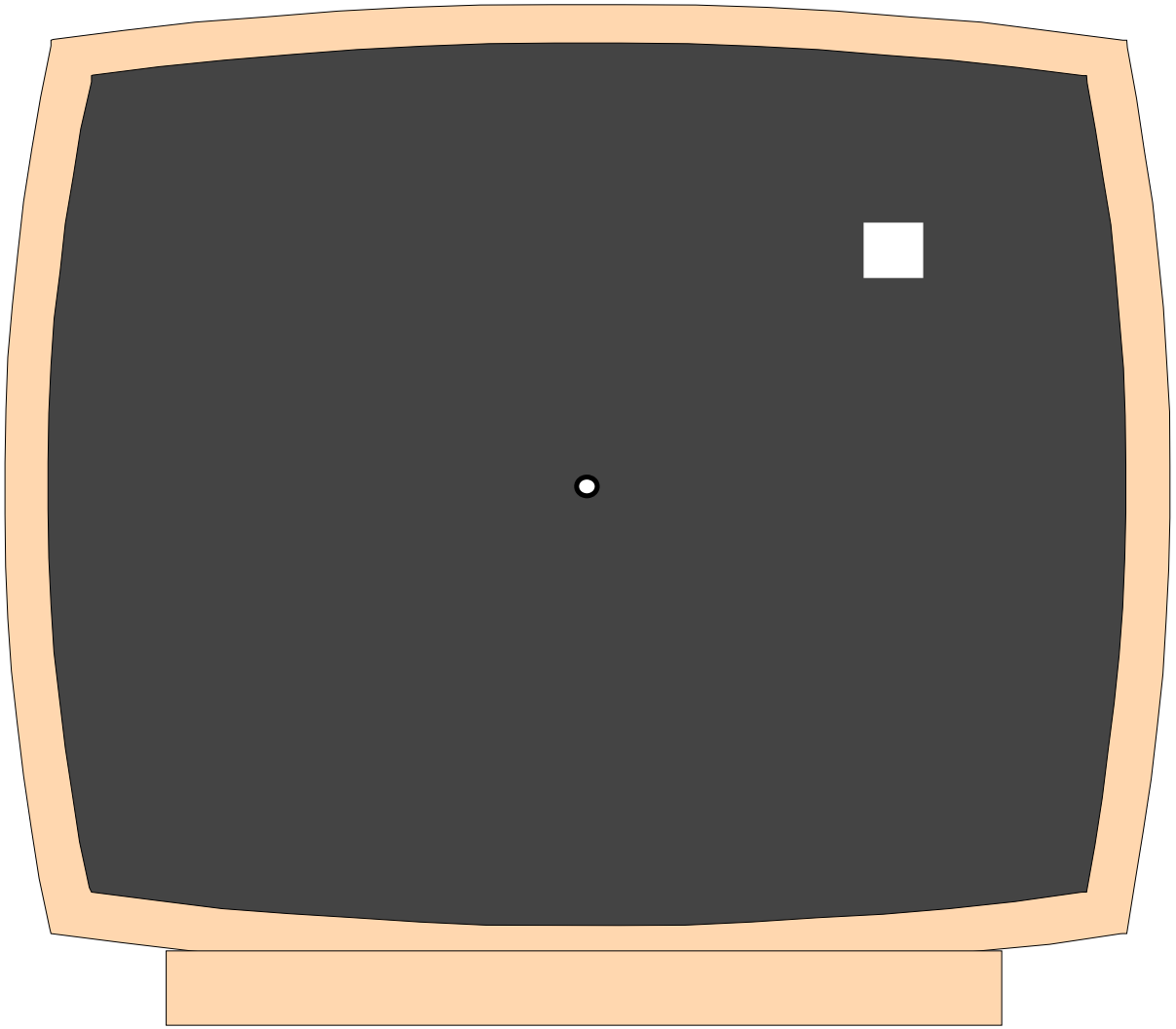

Figure by MIT OCW.


V1
Midget
Mixed
Parasol
V2
W
LGN
P
M
?
MT
V4
Midget
Parasol
PARIETAL LOBE
TEMPORAL LOBE
FRONTAL LOBE

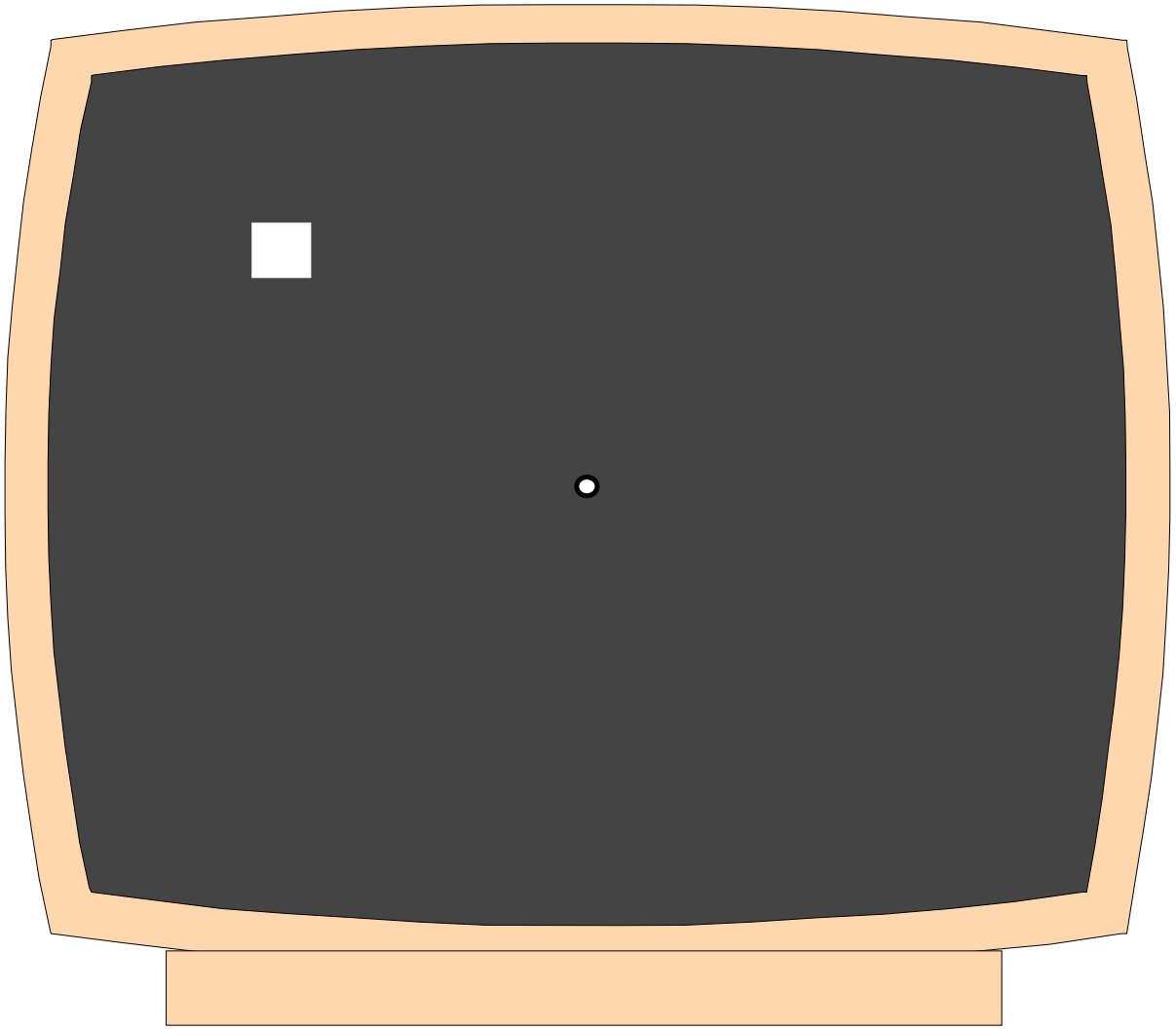
# Lesion studies

# Behavioral procedures

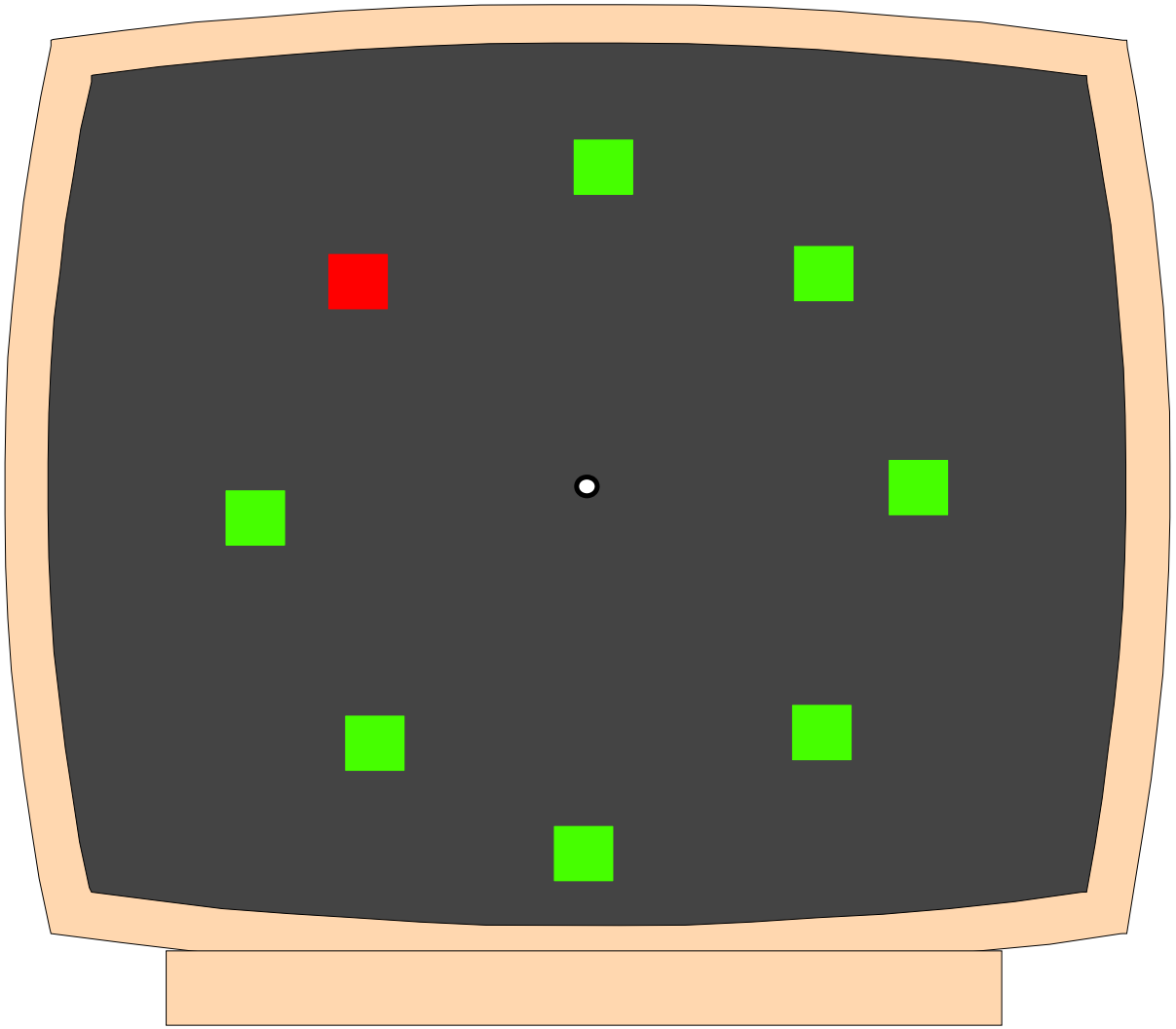
# Detection



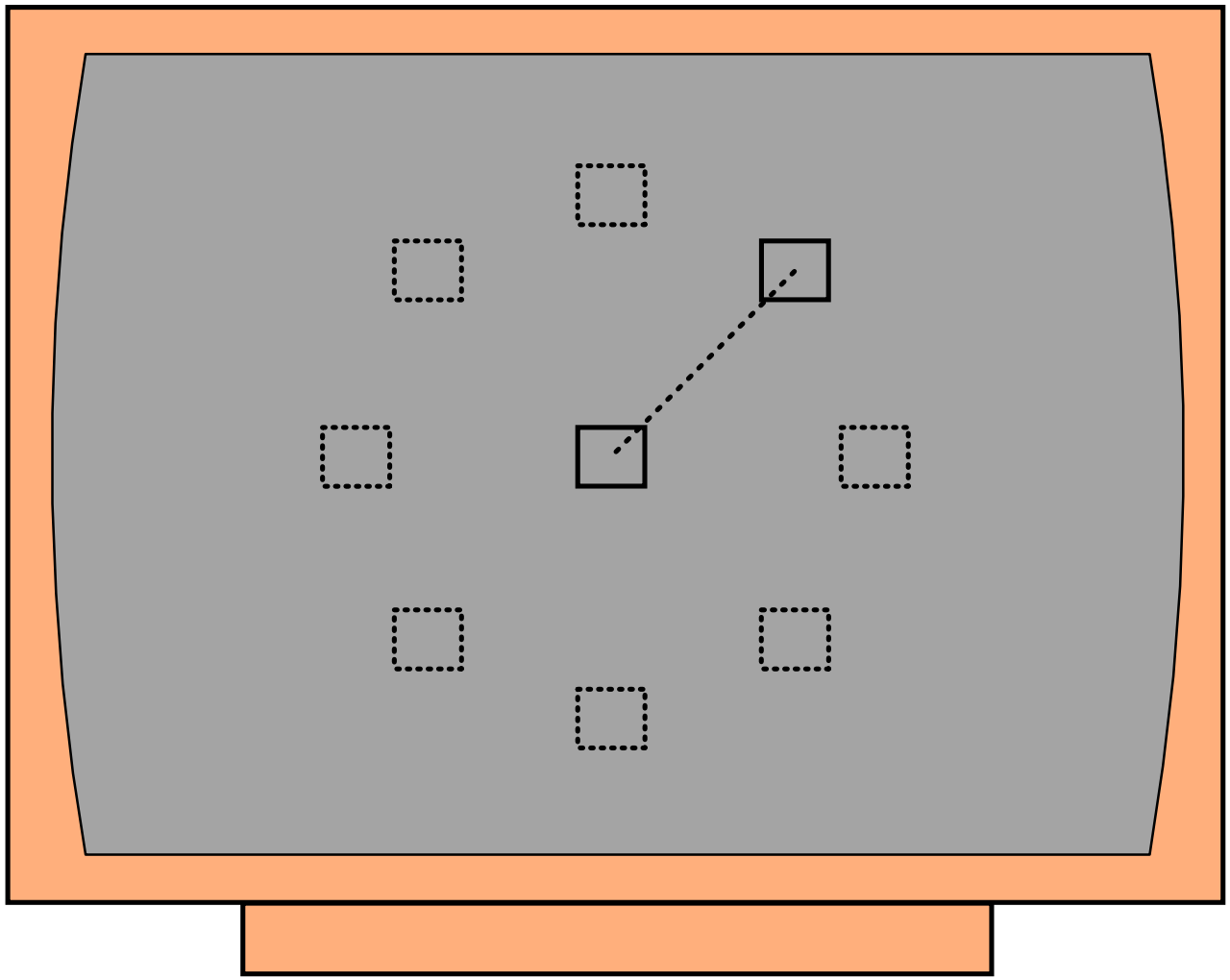
# Detection



# Discrimination



# Performance Monitor



# The lesions

# PERCEPTUAL FUNCTIONS TESTED

Contrast Sensitivity

Color

Pattern

Texture

Shape

Stereopsis

Flicker

Motion

Brightness

Scotopic Vision

# Contrast sensitivity

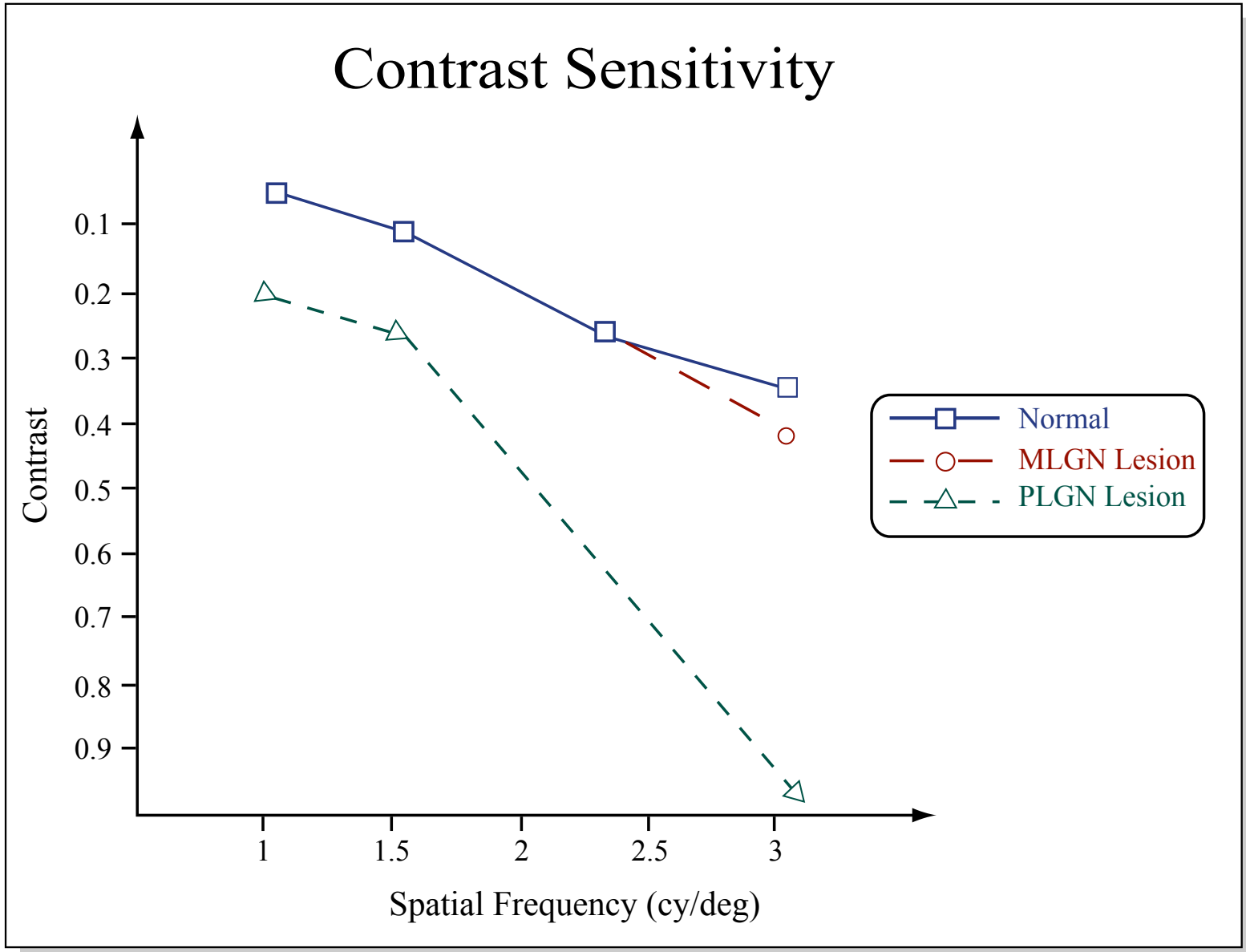
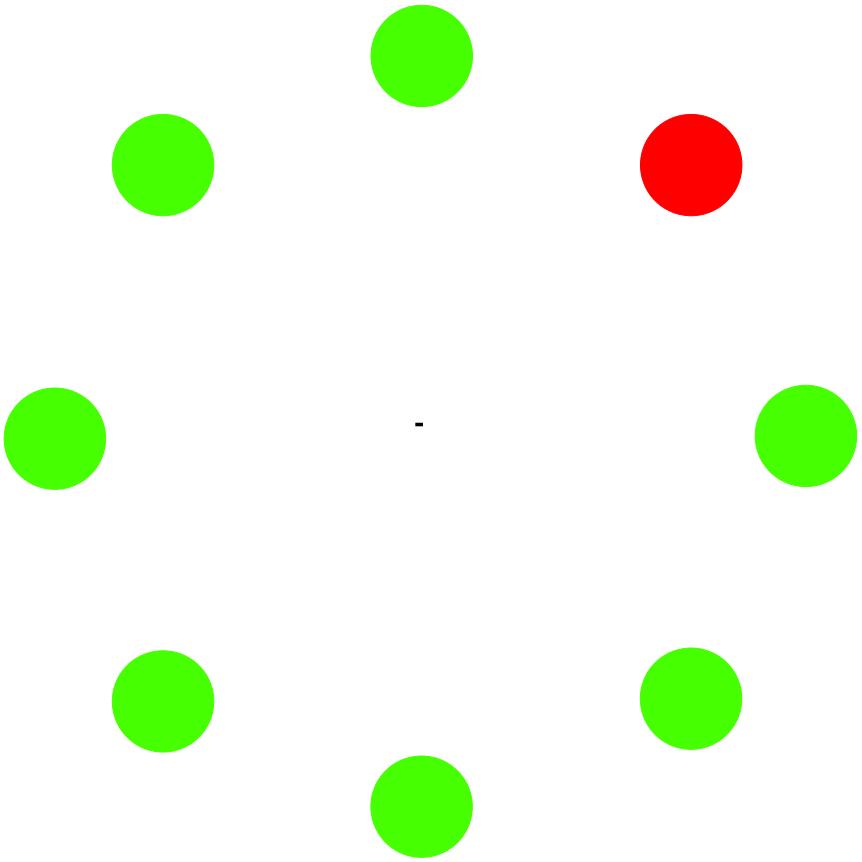



Figure by MIT OCW.

# Color vision



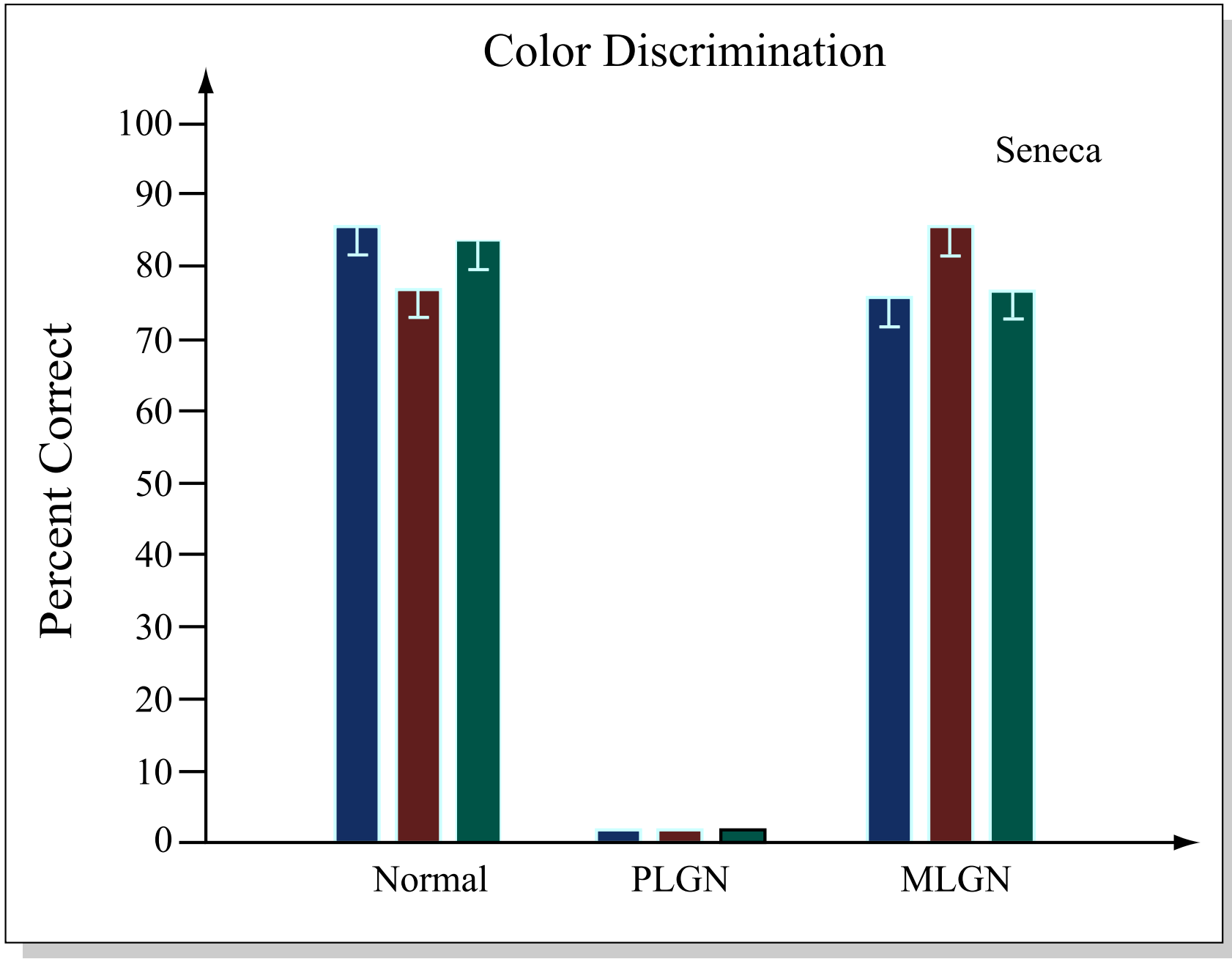
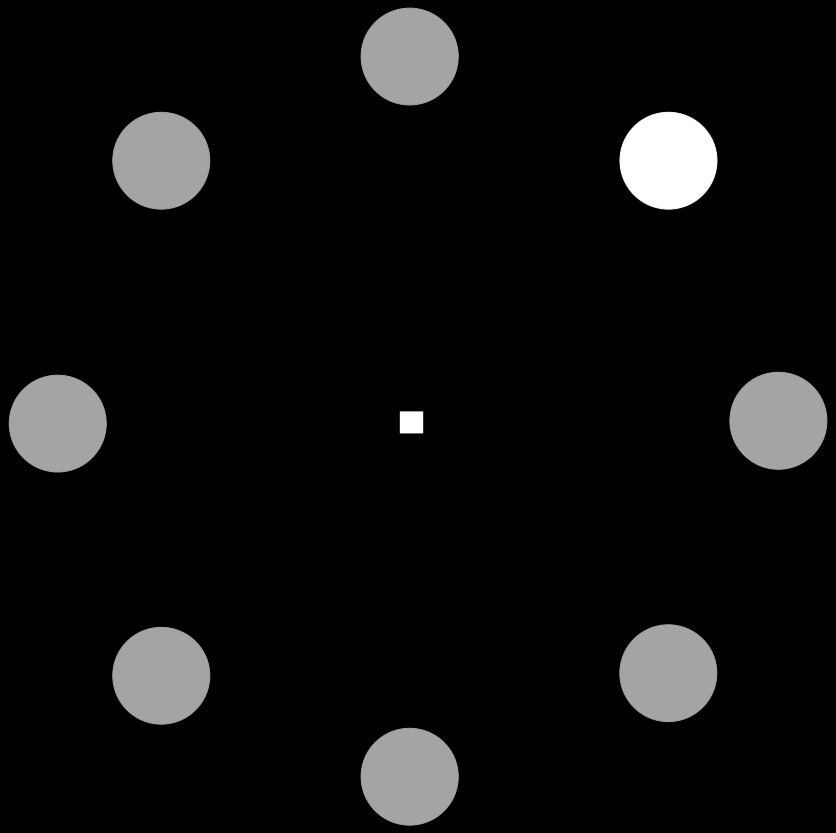
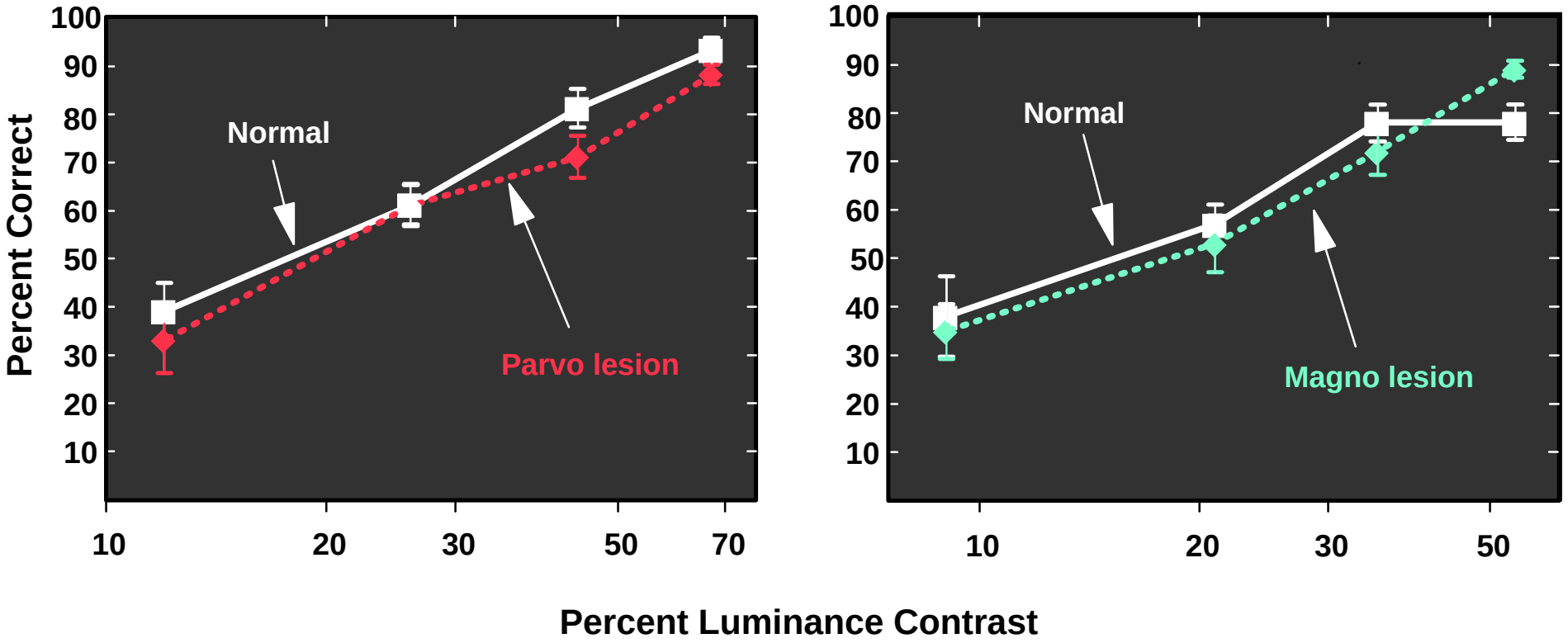



Figure by MIT OCW.

# Brightness perception



# The perception of brightness in photopic vision



# Pattern and texture perception

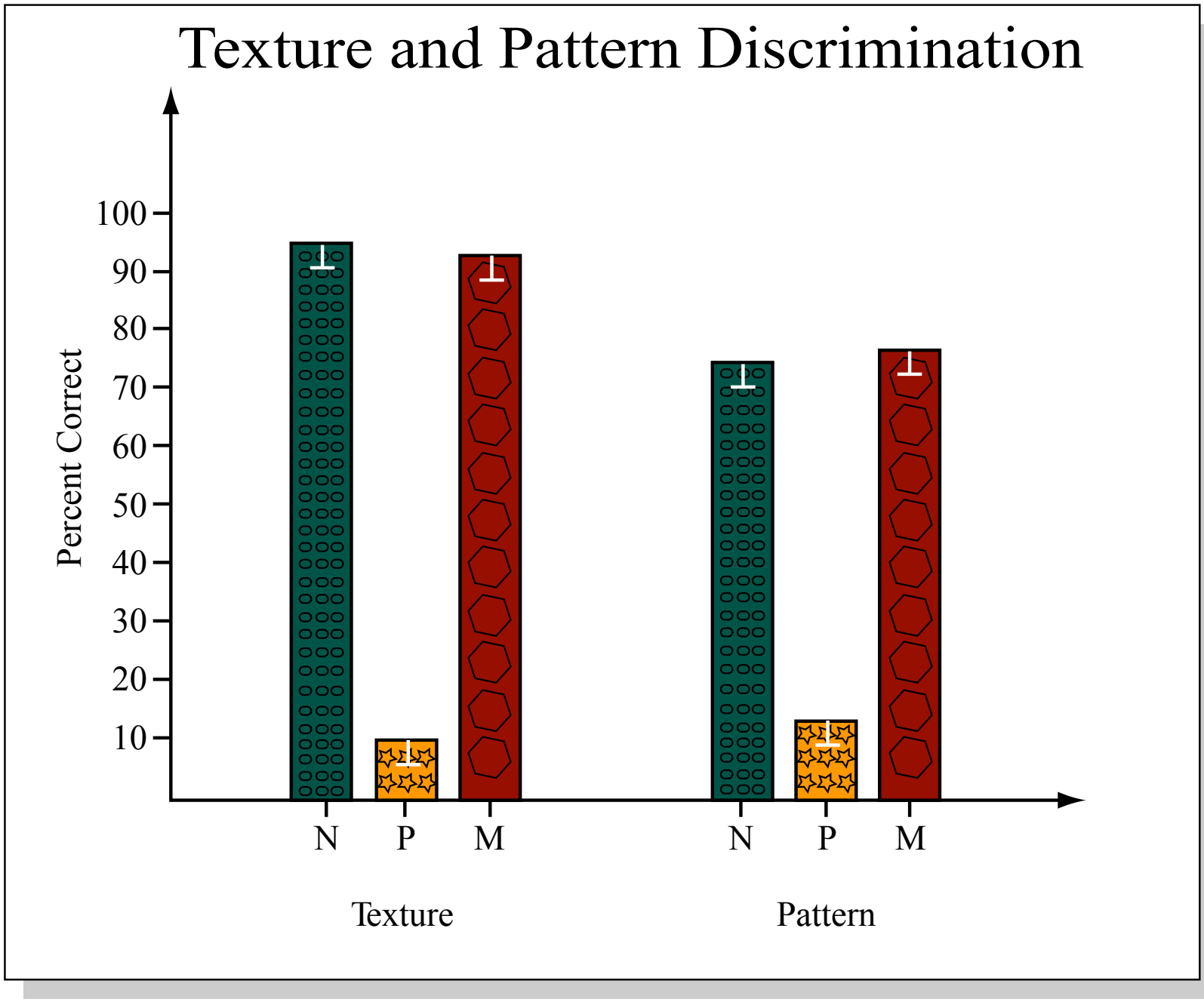
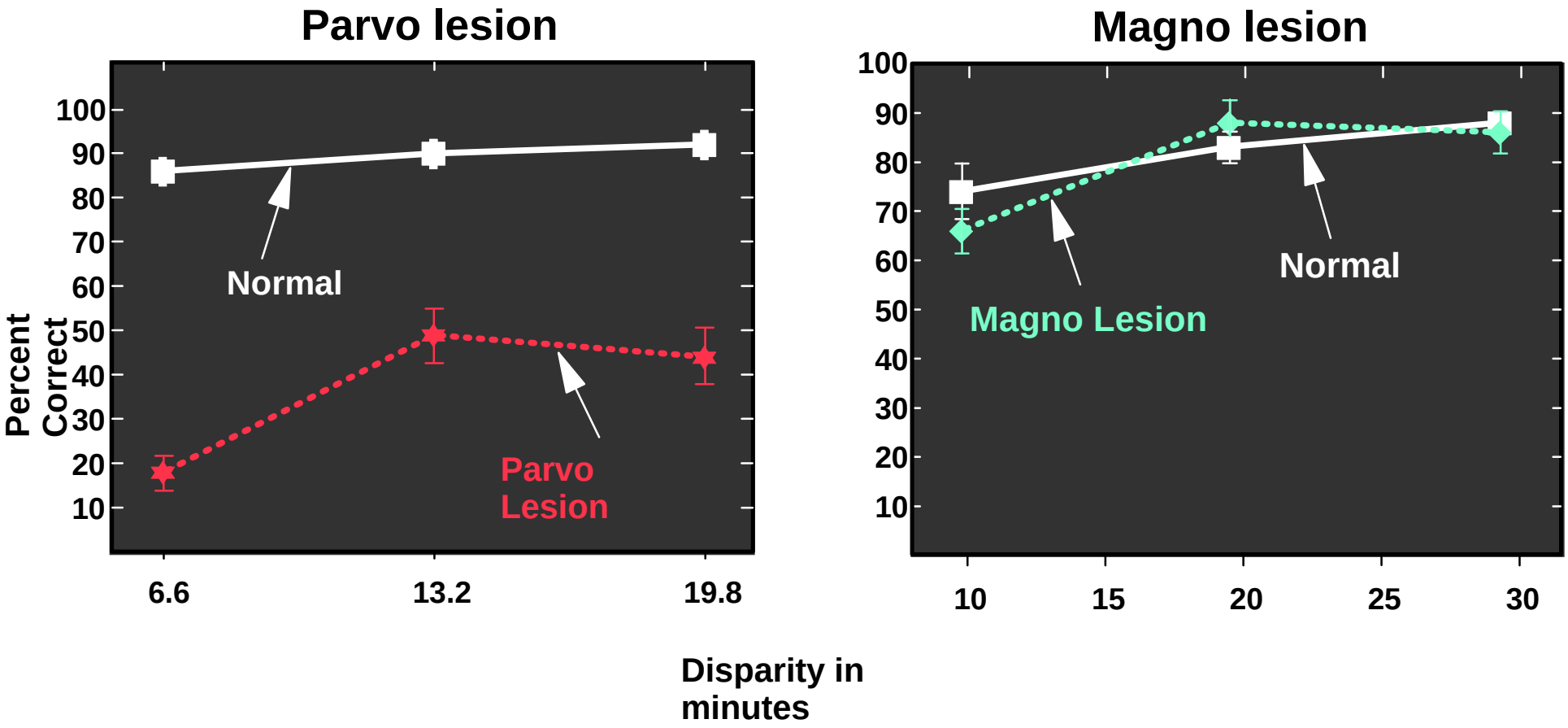



Figure by MIT OCW.

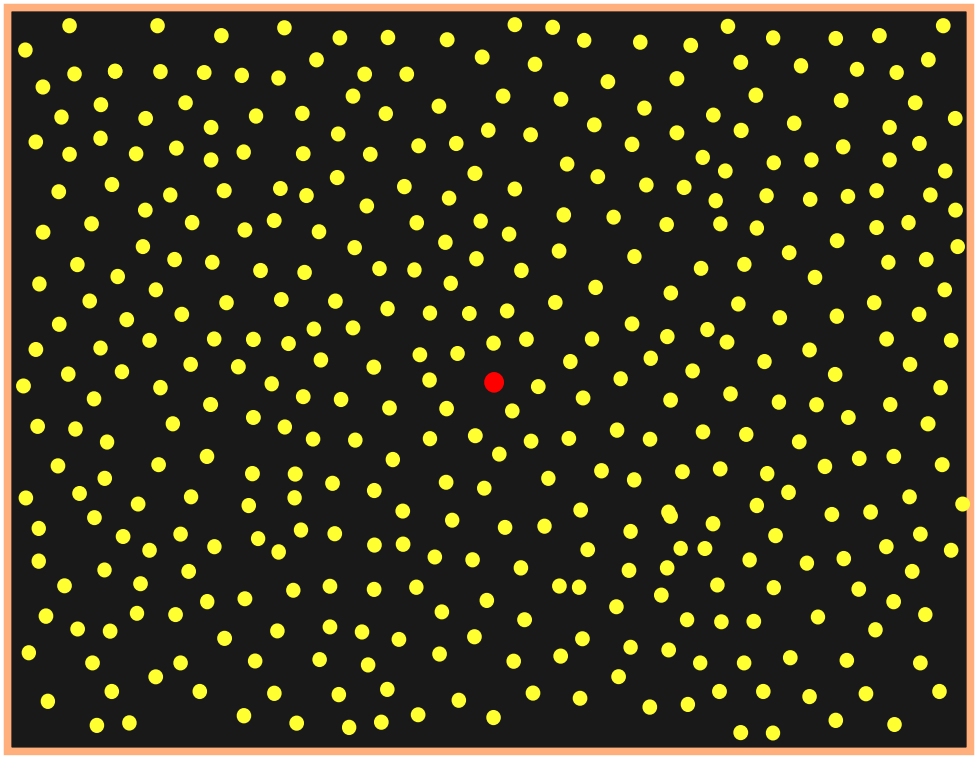
# Stereoscopic depth perception

# Stereoscopic depth perception

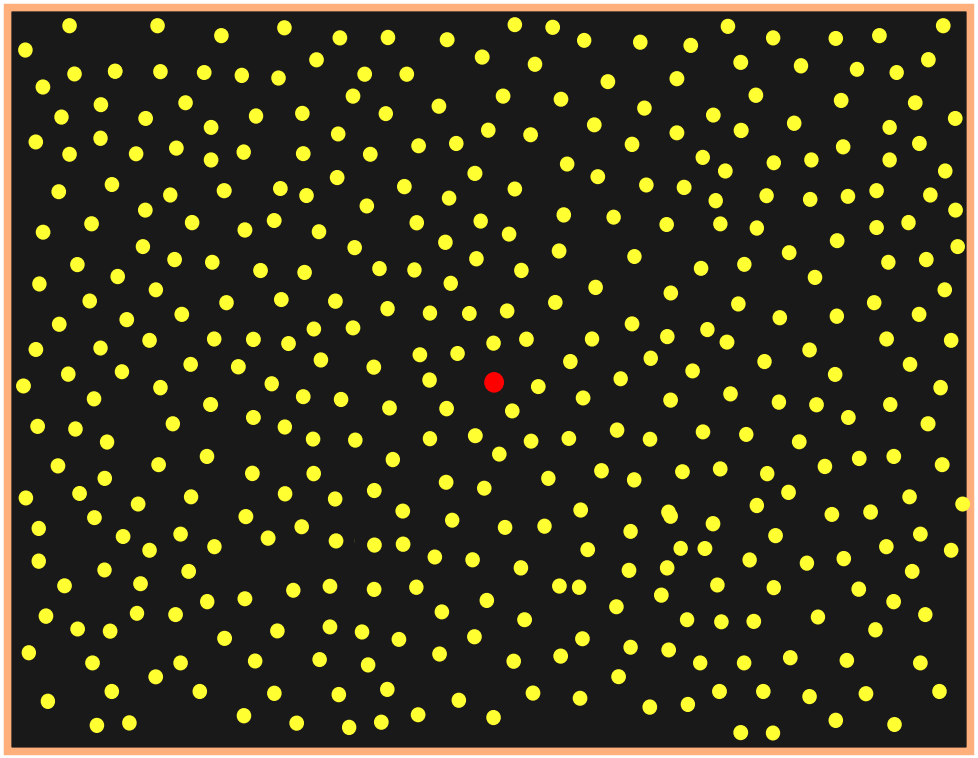


# Motion perception

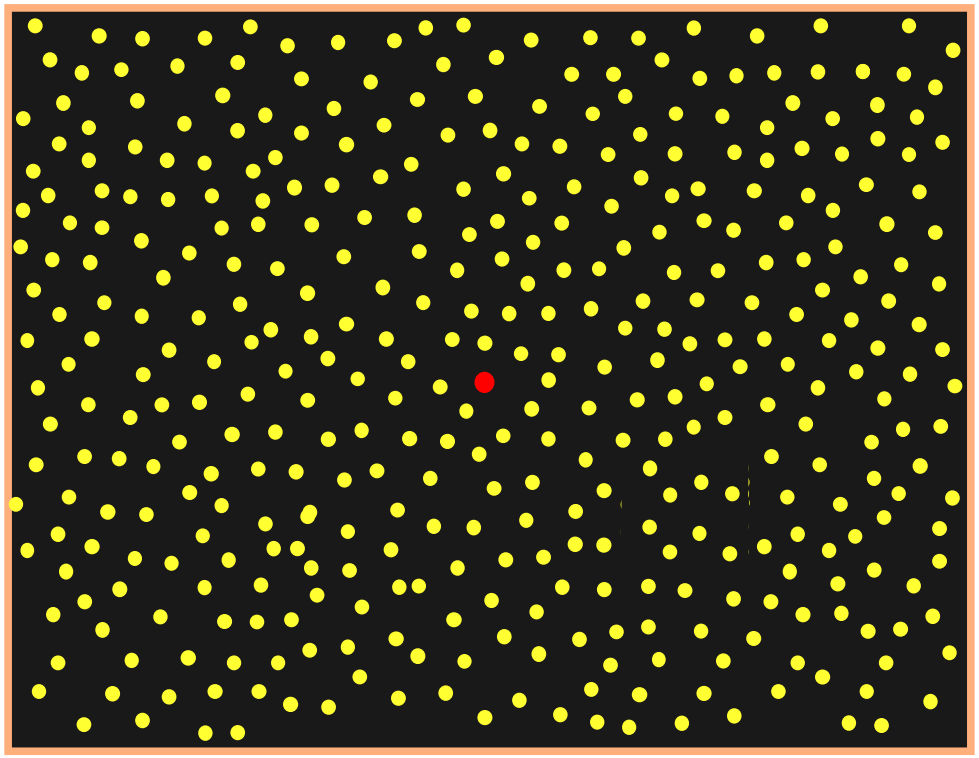
# Motion detection



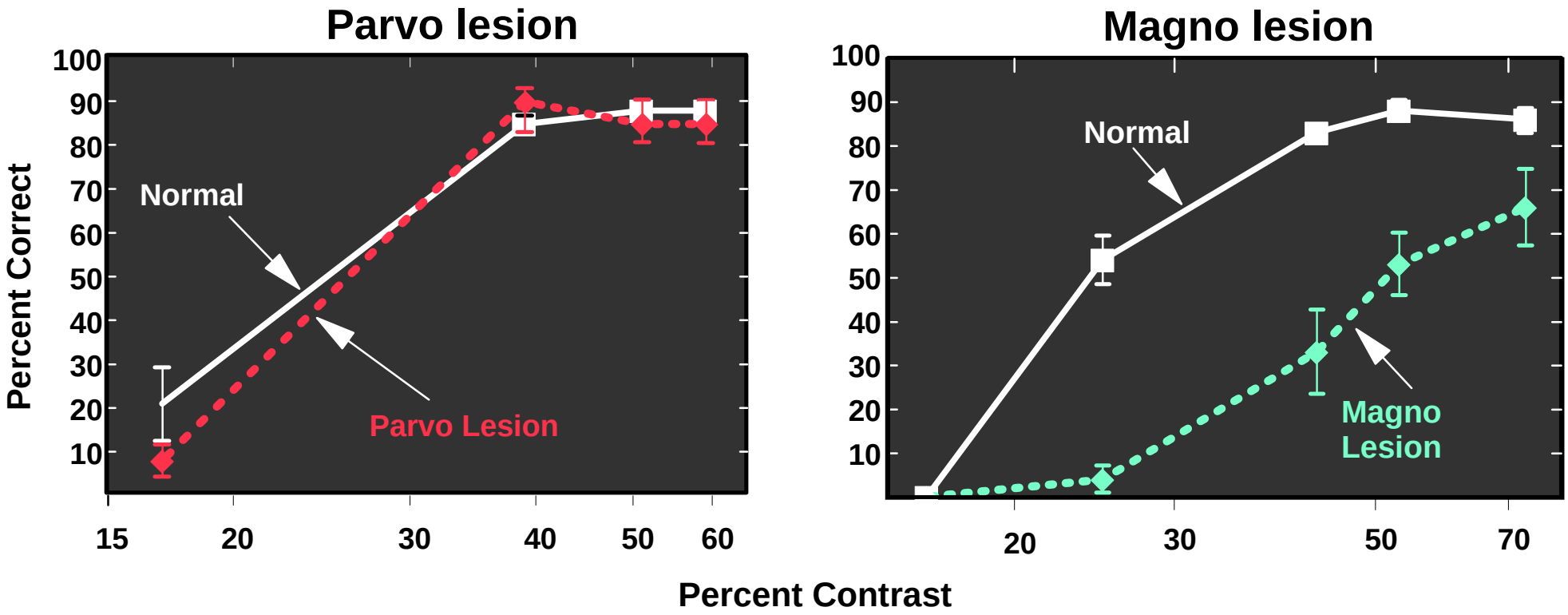
# Motion detection



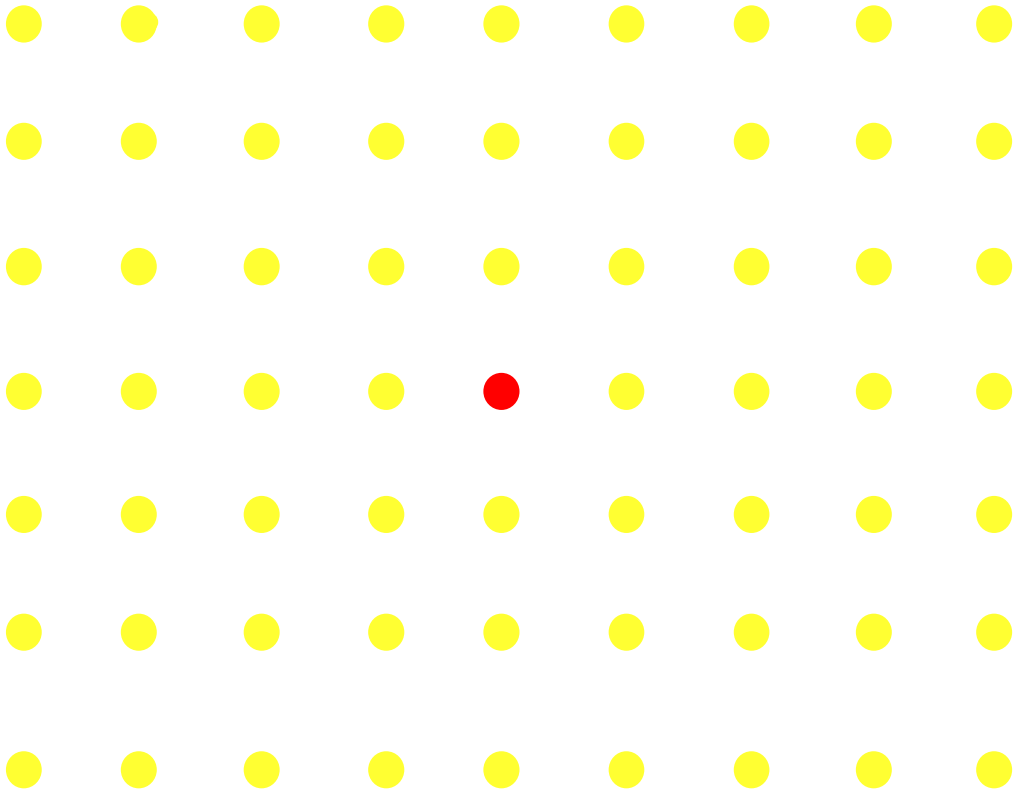
# Motion detection

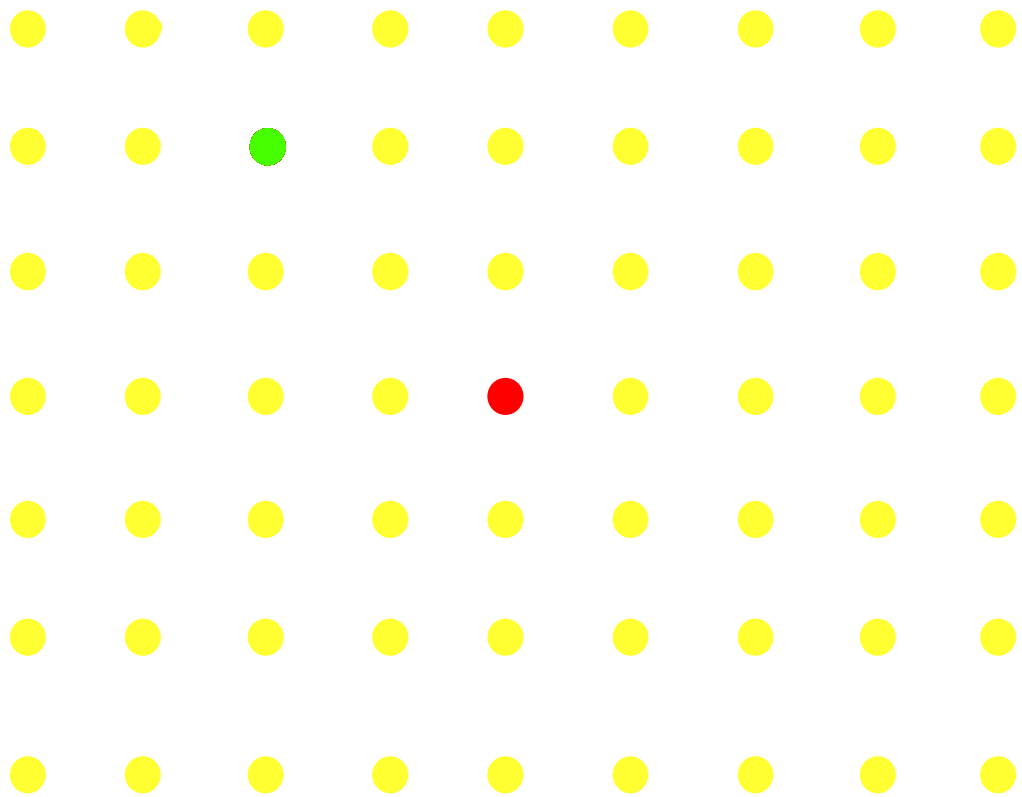


# Motion detection

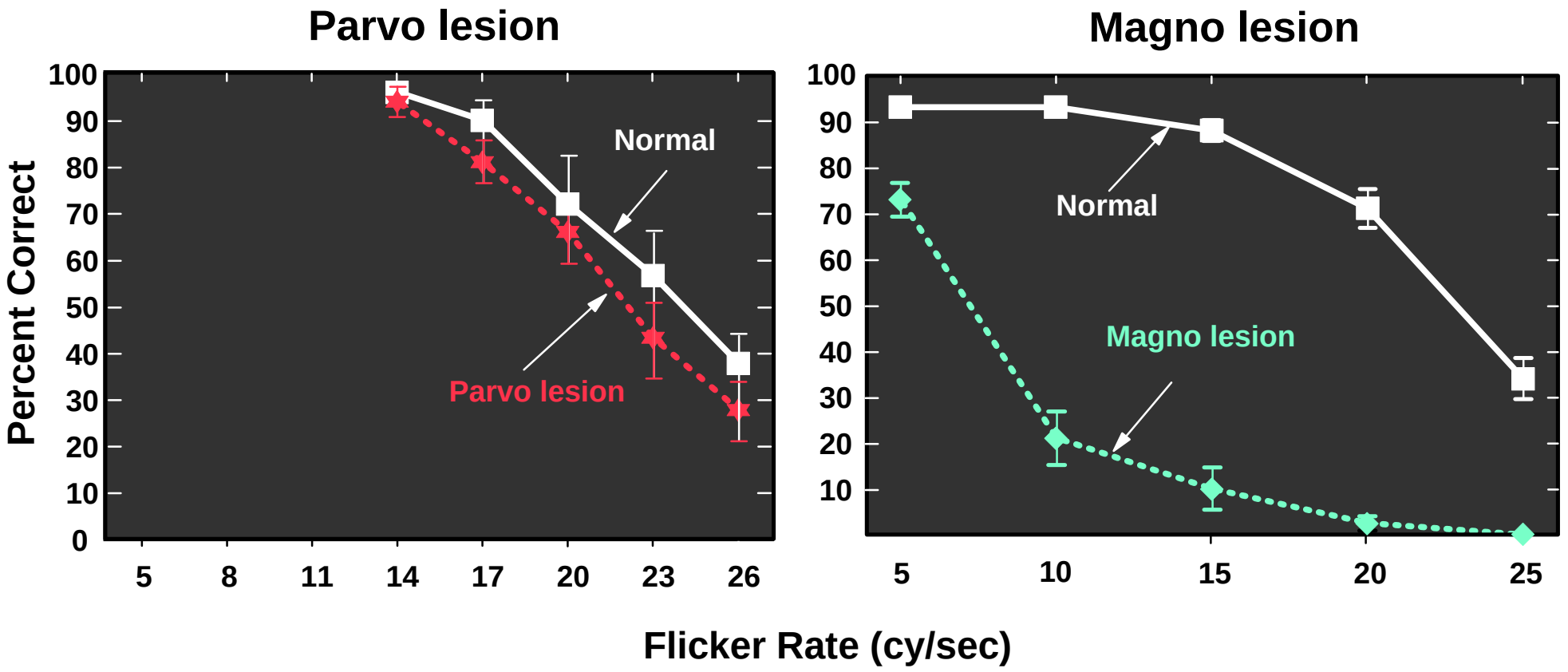


# The perception of flicker





# Flicker perception



# Deficit magnitude following PLGN, MLGN, V4 and MT lesions

| | VISUAL CAPACITY | | PLGN | MLGN |
|---|---|---|---|---|
| BASIC VISUAL FUNCTIONS | color vision | | severe | none |
| | texture perception | | severe | none |
| | pattern perception | fine | severe | none |
| | shape perception | fine | severe | none |
| | | coarse | mild | none |
| | brightness perception | | none | none |
| | coarse scotopic vision | | none | none |
| | contrast sensitivity | fine | severe | none |
| | | coarse | mild | none |
| | stereopsis | fine | severe | none |
| | | coarse | pronounced | none |
| | motion perception | | none | moderate |
| | flicker perception | | none | severe |
| INTERMEDIATE | choice of "lesser" stimuli | | severe | none |
| | visual learning | | not tested | not tested |
| | object transformation | | not tested | not tested |

# Functions of the midget and parasol systems:

| | |
|---|---|
| The midget system : | color |
| | texture |
| | fine form |
| | fine stereo |
| The parasol system: | fast flicker |
| | fast, low contrast motion |
| Both Systems: | brightness |
| | coarse form |
| | coarse stereo |
| | slow flicker |
| | slow, high contrast motion |
| | scotopic vision |

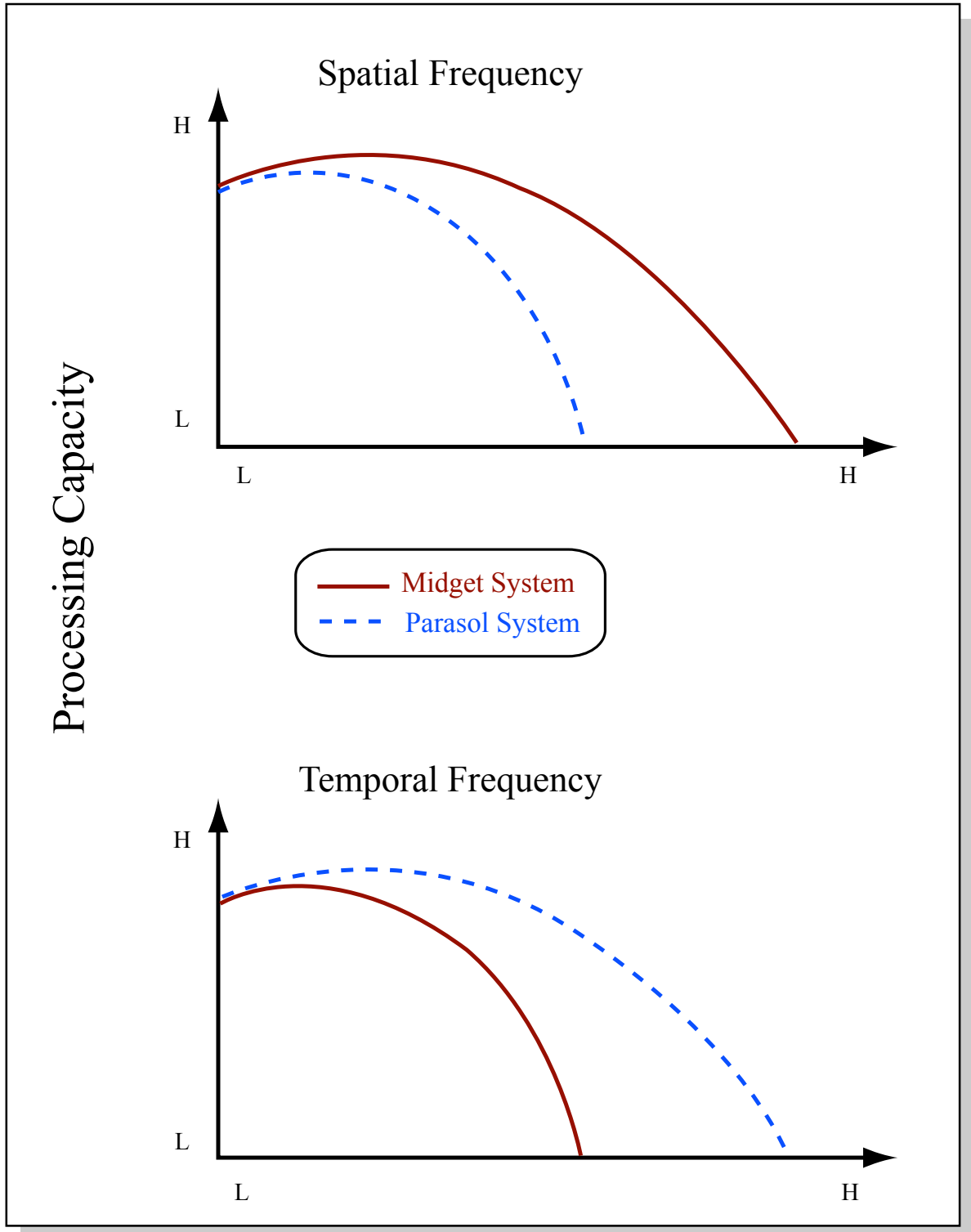



Figure by MIT OCW.

# Summary:

1. Two major channels originating in the retina are the midget and the parasol.
2. In central retina the receptive field center of midget RGC and parvocellular LGN cells is compised of a single cone.
3. Parasol cells have much larger receptive fields; the cone input is mixed in both the center and the surround.
4. The midget and parasol cell ratio from center to periphery changes from 8 to 1 to 1 to 1.
5. The midget and parasol systems converge on some of the cells in V1.
6. V4 receives input from both the midget and parasol cells.
7. The major input to MT is from the parasol cells.
8. The midget system extends the range of vision in the wavelength and high spatial frequency domains
9. The parasol system extends the range of vision in the high temporal frequency domain.

# Recording in V4

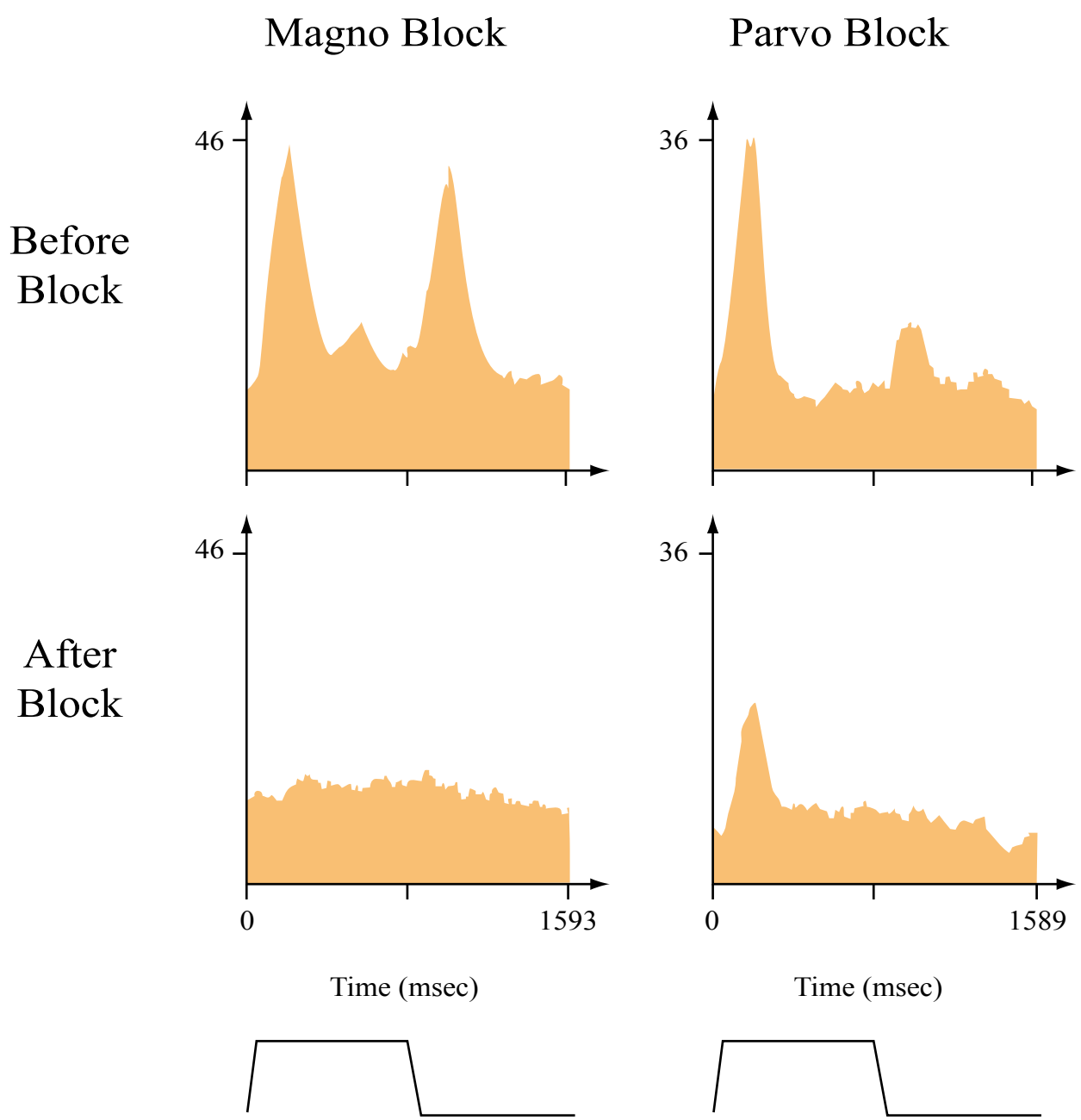



Figure by MIT OCW.

# Recording in MT

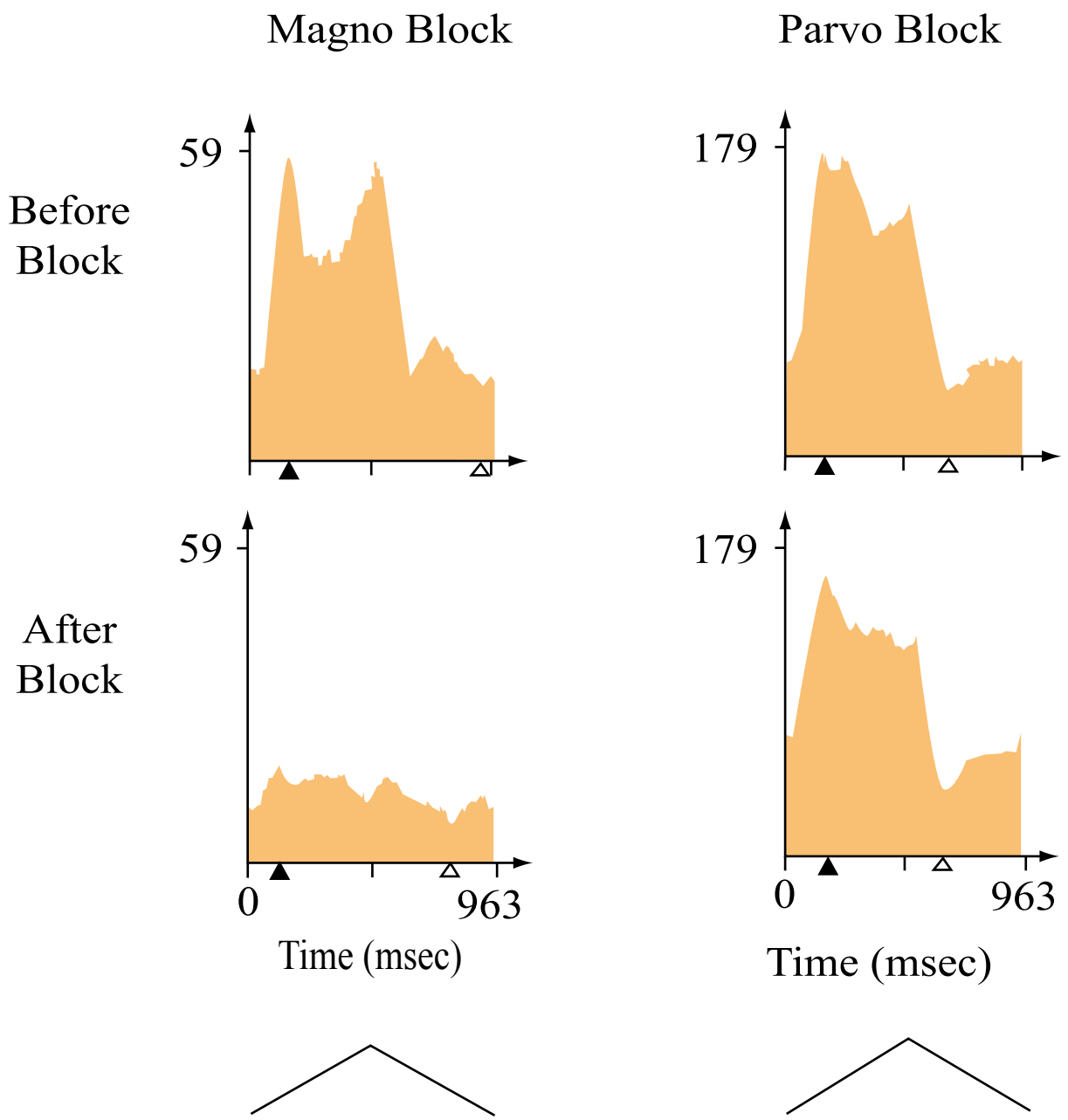



Figure by MIT OCW.

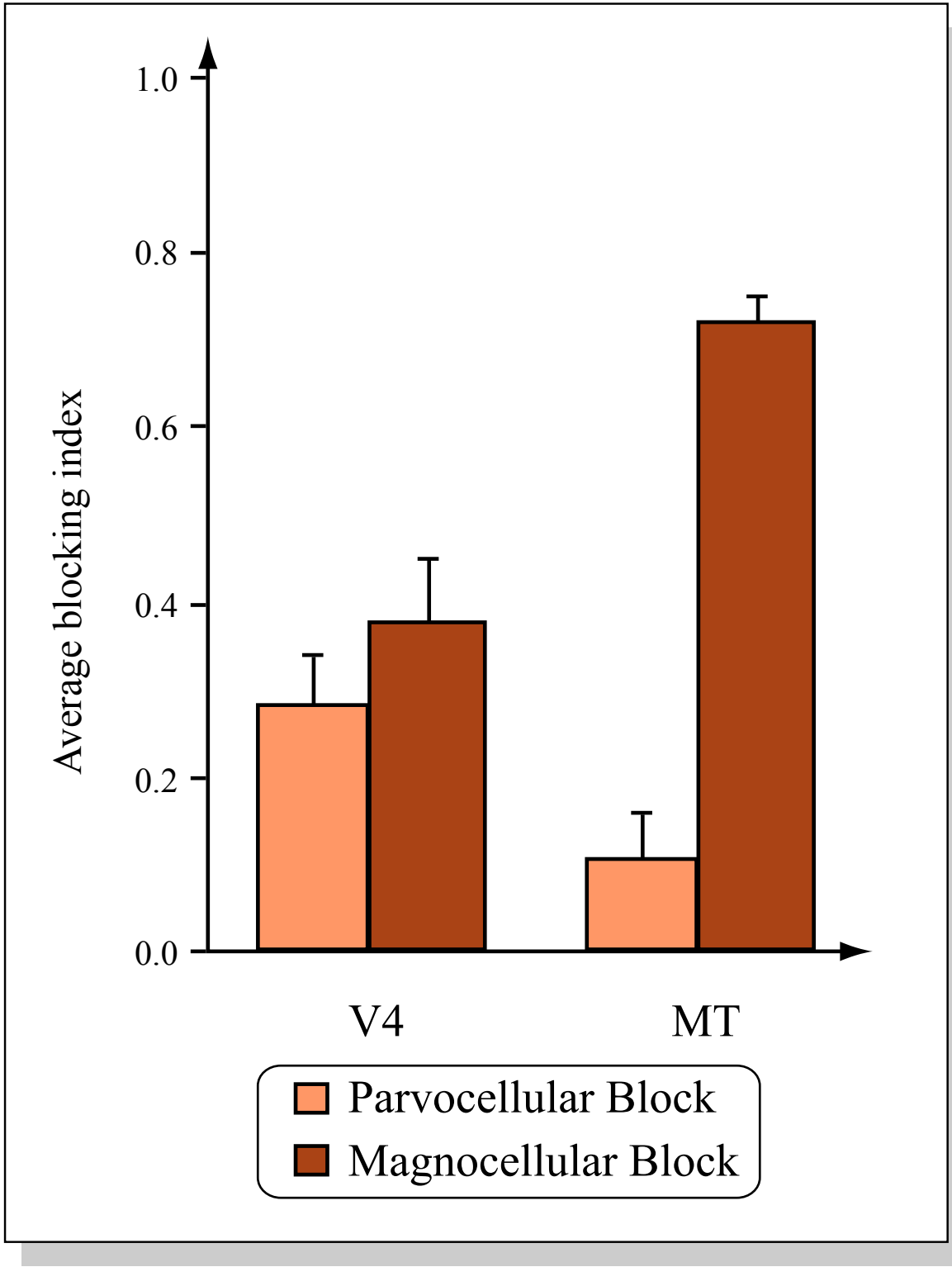
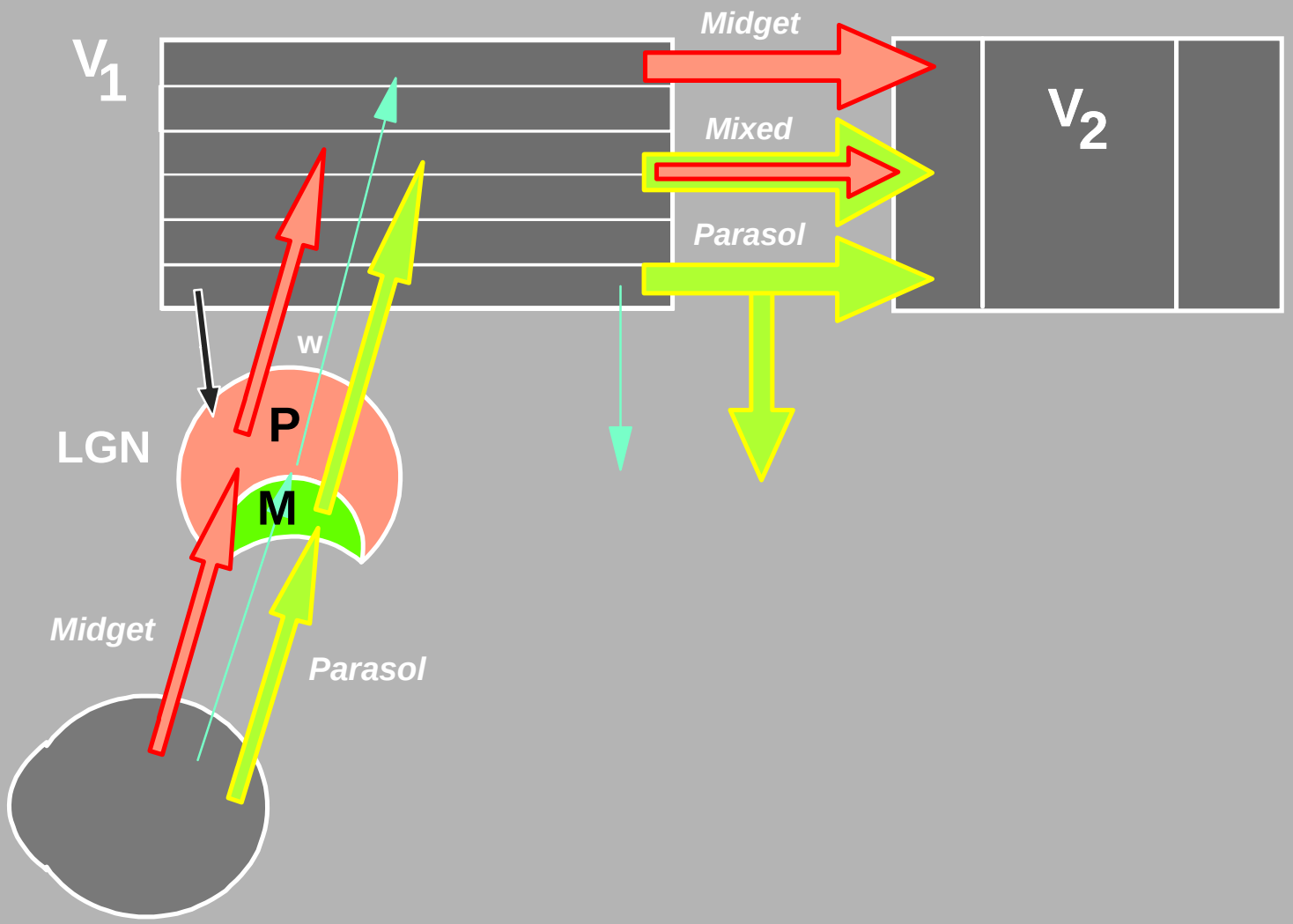
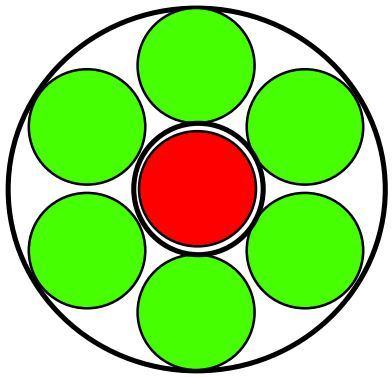



Figure by MIT OCW.

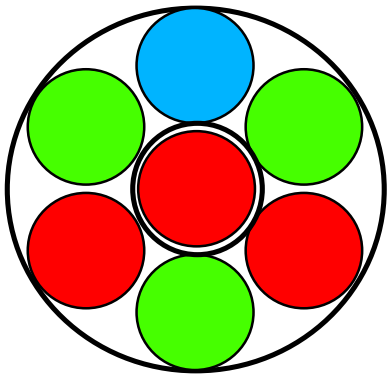

V1
Midget
Mixed
Parasol
V2
W
LGN
P
M
Midget
Parasol

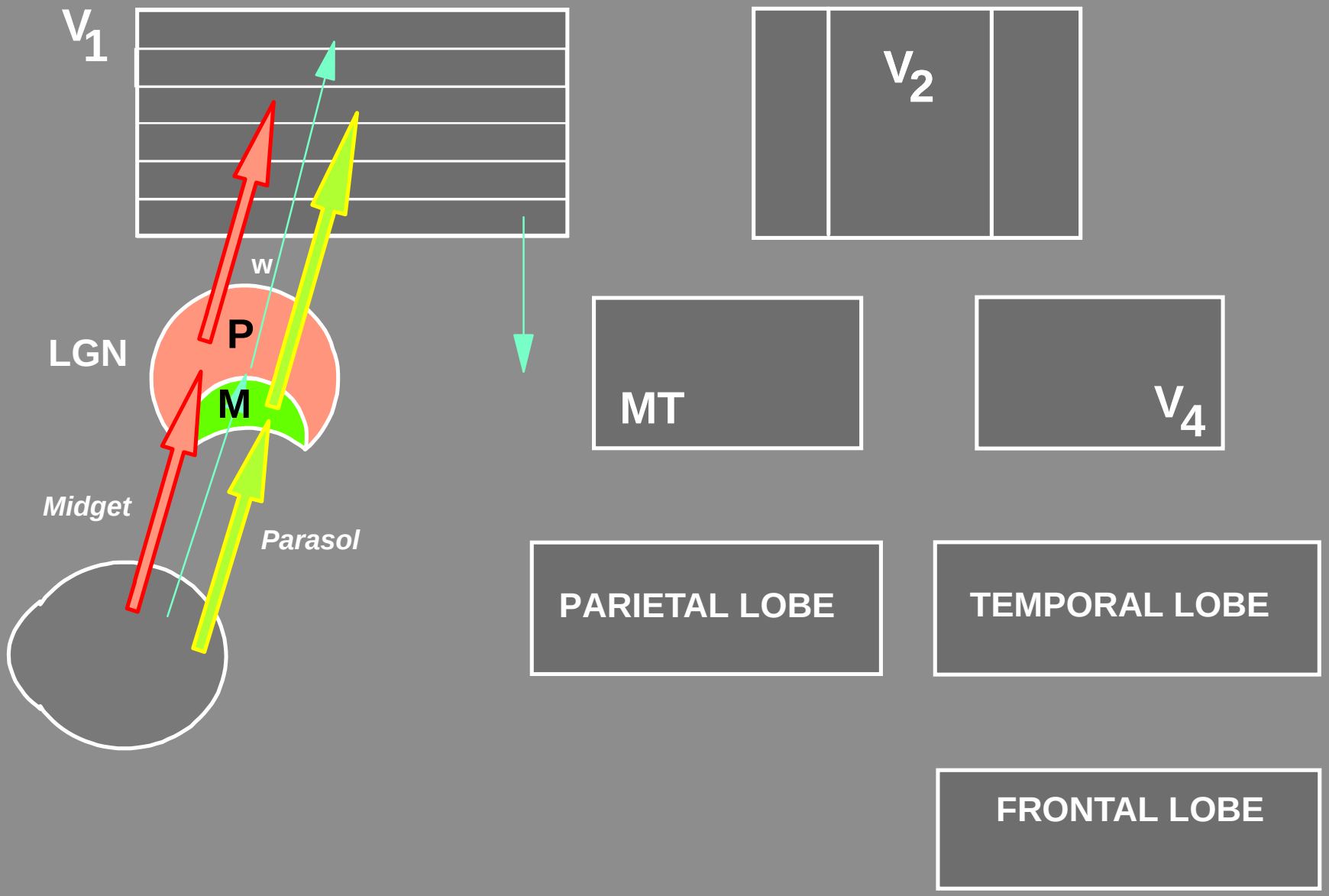
How selective are individual horizontal cells in their connections with cones?

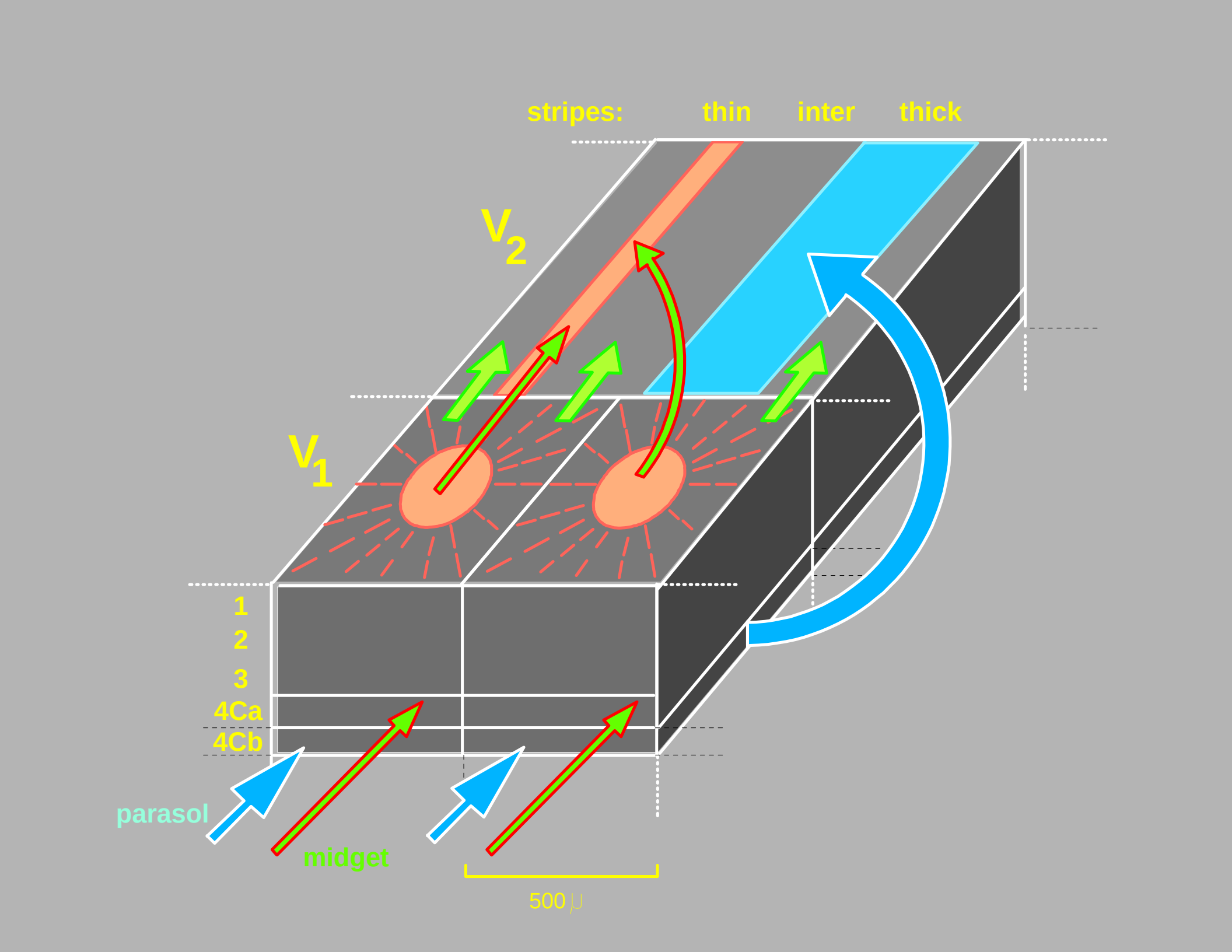
**Model 1**



**Model 2**




V1
V2
W
LGN
P
M
MT
V4
Midget
Parasol
PARIETAL LOBE
TEMPORAL LOBE
FRONTAL LOBE


stripes:
thin
inter
thick
V2
V1
1
2
3
4Ca
4Cb
parasol
midget
500 μ

# The blue/yellow koniocellular system